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SCIENCE AND INDUSTRY IN U.S.A., U.K. AND CANADA*

ALMOST the first thing that we realised on reaching U.K. was that the Universities were devoting themselves entirely to those lines of work which were of direct interest to the war effort. As a matter of fact, no teaching work, in the usual sense, was being carried on in any of the Arts faculties. In Science, only such subjects were being taught which either prepared the candidates for the armed services or were of immediate application in connection with the war effort, and all the learned Professors, whether they were practical science men or mathematicians, were engaged in scientific war work. Those who were not working in the laboratories were engaged in interpreting, correlating or statistically examining the data collected by experimental workers and analysing them with a view to arrive at correct interpretation of the results in furtherance of the war effort. We were often questioned by people, who wished to know something about India, as to why the scientists in India devoted less attention to practical applications and were much more interested in the theoretical sciences like mathematics, mathematical physics and astronomy. My friend, Professor Saha, was questioned as to why he interested himself more in the heat of the stars rather than in the manufacture of thermometers and thermocouples to measure heat. They asked us why, when we had an eminent Nobel prize winner amongst us, who had worked all along in optics, we could not manufacture either a lens or a prism. How was it, they argued, that while two of us were Fellows of the Royal Society and specialists in Magnetism, we could not produce electrical machinery or even a permanent magnet. These were significant questions which showed the trend of the present-day scientific thought in Great Britain.

The danger which constantly menaced life and work in England during all these years of bombing and the V-weapons did not frighten away the spirit of science from that country. On the other hand, it gave the scientist a new courage, as a result of which England has now to her credit some most outstanding discoveries which were achieved during this period of travail. As examples, I may just mention that the medicinal use of Penicillin was developed in that country during this war and the actual pilot plant procedure was worked out during the worst days of the battle of Britain, the radio location and the Radar—the instrument by which enemy planes are located by means of short radio waves—were similarly developed under conditions of great difficulty. At least one plastic material which is already playing a very important part was discovered in England during the war. This plastic called Polyethylene, has been obtained from the organic gas, ethylene, by linking together the simple ethylene molecule consisting of one carbon and two hydrogen atoms into giant groups of 2,000 or more molecules under extreme pressure at high temperature. This remarkable resin is flexible and tough and has most extraordinary electrical properties, which find their chief uses in high frequency electrical equipment where it combines negligible power loss with ability to withstand extremes of temperature. In fact, it can be said that but for the discovery of this synthetic plastic during the war, it would have been impossible to make any real headway with the manufacture of Radar equipment for the radio location of aeroplanes. It is a common belief that the Battle of Britain was won by the Physicist through the discovery of Radar. It would be equally true to say that the Chemists have not been far behind, for, by making this synthetic plastic material available they made the manufacture of Radar equipment possible.

England has taken vast strides in scientific research; this goes greatly to the credit of British ingenuity and skill in science. But there is one shortcoming in England which one irresistibly notices in comparison with America. The trouble with England is that Industry in that country is not yet research or technically minded to the same extent as it is in America and thus large-scale process-

* Extracts from an address delivered by Sir Shanti Swarup Bhatnagar at the Central India Centre of the Institute of Engineers (India), on Thursday, the 29th March 1945. The Hon'ble Sir Ardeshir Dalal, Member for Planning and Development, Government of India, presided.

ing in England lags behind pure scientific work. It can, perhaps, be freely admitted that while some of the most important discoveries mentioned above like Penicillin, polyethylene, radar, etc., originated in England, they had to go to America for immediate large-scale production. The U.S.A. scientists and technicians have perfected to a high degree of efficiency that process of intimate co-ordination between science and industry which is so essential for any large-scale production.

We noticed in England that the Industrial laboratories and the laboratories of the Factories, which are engaged on war work, were gradually being remodelled on the liberal scale which is the feature of American research organisations. Large as well as small firms are becoming research-minded and they are employing research Chemists and Physicists to produce new and better things. The scientific workers in U.K. industries were now busy devising methods by which it may be possible to put discoveries made in the laboratory on a large-scale production within a reasonable time.

Of the great many discoveries made during the war-time, I have to restrict myself to describing only a few of the more important ones. Amongst the most notable American achievements in Metallurgy and Chemistry may be mentioned:

(1) Manufacture of Aluminium from clay and the development of new Magnesium-Aluminium alloys.
(2) Advances in Magnesium technology, particularly the process of recovery of magnesium from sea-water.
(3) Development of a method of continuous pouring of an ingot of aluminium up to any desired size, which has made practicable the continuous rolling of aluminium on a large scale.
(4) Making of a new National Emergency steel (N.E. steels) whose main characteristics are lean alloy contents, and better tempering by quenching in oil or salt-baths.
(5) Development of high temperature-resistant steels which are used in super-chargers, gas turbines, jet propulsion devices.
(6) Gas turbines, which when fully developed, will displace both large diesel units and small steam turbines.
(7) Centrifugal casting of metals by means of which alloys can be made in non-forgeable and non-machinable grades.
(8) Powder metallurgy.
(9) Sintered carbide tools.
(10) Plastic bonding of metals.
(11) New electrolytic tin plating process which replaces the old dipping method.

One of the most interesting developments in the chemical field is the growth of the British war-time sulphuric acid industry. The process of making sulphuric acid from gypsum derives its main importance from the fact that a Portland cement is produced as a byproduct. This method has enabled the United Kingdom to increase its acid production to the extent of double of pre-war output. The large quantity of cement produced in this process has resulted in considerable reduction in the cost of sulphuric acid.

Penicillin furnishes an example of a product discovered by two English workers, Fleming and Florey, which could not be developed into large-scale method until America took up its production. In hardly two years' time the manufacture has now reached a figure such that the drug is freely available for all war needs and in somewhat restricted manner for civilian use also. Side by side with increase in production, the price has been reduced to less than a quarter of 1943 figure. It is interesting to note that there is one single plant in America which is preparing something like 90 per cent. of the world's production of this drug, the rest 10 per cent. being made in 26 small factories in America, Canada, England and Russia.

I have already mentioned some features of the progress in the technique of metallurgy. The new method for the manufacture of aluminium from clay has changed the face of aluminium industry. Similarly the process of reclaiming magnesium from sea water marks a revolutionary change in the metallurgy of this material. The cheap production of magnesium by this new method has led to some remarkable developments in the alloys of this metal with aluminium. Some of these new alloys have a tensile strength comparable with that of steel and this fact together with their lightness has led to their extensive use in aircraft construction. The production of the alloys of magnesium and aluminium has been put on new lines which promise to be of great interest to the metal kingdom.

Synthetic rubber is another industry entirely developed during the war. Several methods of making synthetic rubber and rubber-like resins from coal are in active utilization. The fact that we are short of natural rubber makes these discoveries of the greatest value. I do not suggest that synthetic rubber has sealed the future of natural rubber or that the allied armies need not win back the rubber fields from the enemy hands. What I wish to say is that there will be sufficient synthetic material available for supplying every requirement in which rubber is used, even if the natural sources are not available for sometime. We saw many factories and several laboratories where further developments were being made on a big scale.

One of the most significant laboratory achievements of the recent times is the success in the replacement of certain carbon atoms in the molecule of some resins by those of silicon. Silicon most abundantly occurs in combination with oxygen as sand and an organic compound of silicon has been made use of to replace carbon from the usual type of substances used in making plastics. The new resin called *silicone* has been found to have some remarkable properties. Used as an insulating varnish, it bids fair to revolutionise the electrical industry. Merely treating the surface of cotton, paper or glass with it, leaves a water-repellent film which can withstand washing, dry-cleaning and considerable abrasion. Ceramic insulators treated with this varnish are used in aircraft radios as they are not made conducting by the disposition of

moisture on them. Silicone oils stay fluid even at very low temperature and are still usable upto 400 to 500° F. Made into rubber-like materials, silicones are proving valuable as in superchargers and searchlights, where their heat resistance enables them to perform heavy duty under which other materials break down. Insulating and heat-resisting properties of this resin are higher than those of other known resins, and as such it is bound to play a very important part in the Electrical Industry for making water-proof insulating material which can operate continuously at high temperatures for long periods. This has already led to considerable reduction in the size of electrical motors and generators. The General Electric Co., Schnectedy, U.S.A., has evolved another interesting material of this very type. This resin has the additional virtue of being lighter than water, and so it is finding important uses by the Navy. Because of its resistance to heat and moisture it will be a great asset not only to the electrical industry in general but also to the water-proofing industry.

Plastics in America have found use in the shape of lovely colourful jewellery. The coat-hanger in green is made from a plastic resin. It is flexible, light in weight, fits in the wardrobe quite easily and is available in a variety of beautiful pastel colours. The 'pearl' necklace has plastic beads with iridescent plastic paints. There is some other jewellery, too, with plastic emeralds and rubies which may one day be as good as the natural stones. The colourful ladies' handbag is again a plastic product. Another very important thing, which probably many have noticed, is a Chevrolet car gear-wheel. It is as tough as that made of steel but has the valuable quality that it does not make noises which steel gears do. An idea of the extent to which machine and other parts are being made from plastics can be gathered from the fact that an aeroplane to-day has over 1,000 parts made of plastics and a battleship over 50,000.

I shall only make a passing reference to the unburstable containers and jettison tanks. It may be known to some of you that one of the things which we did early during the war was the production of unburstable containers and jettison tanks. These were made from cloth, jute and plastics. These were tested and found to be good by the army in several trials. As a matter of fact they were so good that a British firm in Calcutta was interested in their manufacture in this country. When Calcutta became a danger zone this scheme was abandoned. That tank, which stands vertically, is a 60-gallon tank prepared by us. These were shown to the Engineer-in-Chief in India and to the R.A.F. who were deeply interested and desired that these should be developed on a large scale. Unfortunately, owing to our handicap in putting things on a large scale and also on account of the fact that, as far as England was concerned, jute was not available there, this work could not be developed further. The production was later put on a large scale in America and large quantities were manufactured to drop supplies from air.

I should not at this stage omit to mention that the co-operation of the Engineer and the laboratory worker is of the utmost importance, and they should work shoulder-to-shoulder. In America we found that the Engineers and the Chemists were closely linked together and they worked together in perfect harmony. Unless this combination takes place here and we learn the value of scientific collaboration, it will not be possible for us to make any real progress in industrial development or even in the realm of scientific inventions, because howsoever good an invention may be, the public get interested in it only when it finds application in the things which they know and find useful.

Another development which impressed us very much was the large-scale industrial production of electrical equipment. When I went to England I was under the impression that so far as the hydroelectric developments were concerned, Germany, Norway and America were, so far as the hydroelectric developments were concerned, the last word on the subject, and we found it difficult to believe that even during the war England had developed a very strong industry. We noticed at the Metropolitan Vickers and the English Electric Co. that very large-sized power plants were being constructed.

As an example of things to come, I would like to draw the attention of my audience here to the new post-war Ford car. Those who are now getting industrially inclined with respect to the manufacture of cars in this country may take a peep in the future so that they may not lag behind in this new industry. Plastic sheets employed in the fabrication of the body of the car are made from material of which we have been very proud of in our laboratories of the Council of Scientific and Industrial Research, namely, jute or canvas cloth and plastic. Pressed in moulds the material can be made to take any shape so that the car should be given a streamlined or any other shape. This is the car which is going to be put on the market as soon as the war is over.

America has got a great many laboratories with the most up-to-date equipment in apparatus and facilities. In fact, the equipment of American laboratories has been a distinguishing feature of that country for many years. Among the most notable of these, I may mention the R.C.A. laboratories in Princeton, the Bell Telephone Laboratories in Summit, the Chemical and Engineering and the Technical and Scientific Laboratories of the North-Western University at Evanston, the Geophysical Laboratories of the Gulf Research Co., which have contributed more to the material wealth of America through oil than any other research organisation, the Shell Development Company with its new plastics laboratory and the Standard Oil Co. Laboratories where fluid catalysts are used for purposes of cracking and polymerisation.

We also visited various other scientific organisations and laboratories, such as the Massachusetts Institute of Technology, the Mellon Research Institute, the Batelle Memorial Research Laboratory, the privately owned Universities, the State-run departments such as the O.S.R.D., and the State Universities of America. A new feature of the American laboratory building practice is that the inside

space is now provided with removable walls which enable room space to be altered at will. In the new R.C.A. Laboratory, and the new Bell Telephone laboratory on Murray Hill near New York, one could convert a laboratory room into any size according to requirements within a few minutes. As a demonstration of quick practice we were shown conversion of a room in about ten minutes into something substantially different.

America is the one country in the world which could be said to have solved the problem of poverty and it struck us as a wonderful thing that we did not come across a single badly dressed man. I was, perhaps, the second worst dressed man in America—the pride of first place going to another member of our delegation. We found even the working class well dressed, cheerful and happy. The labour is held there in high regard and is not branded or looked down upon as inferior. This is the kind of spirit which has made the Americans a great nation.

I must not forget to say that, as far as agriculture is concerned, America is really supreme. All the agriculture there is being done by power. The farmer is an educated man and he knows the practical value of fertilisers, rotation of crops, insecticides, grading, marketing, etc., in fact, of all those things which, for us in India, exist only in text-books and nowhere in practice.

In America the natural resources of the country have been fully harnessed and that country should serve as a model to all countries of the world for development of power and its utilisation in automatised industries. Two most notable examples of this are the Boulder Dam and the Tennesse Valley project. A few facts about the Boulder Dam may be interesting here. The Boulder Dam is built across the Colorado river which rises in the rocky mountains and rolls for 1,700 miles through the South-Western States to its mouth in the Gulf of California. This river drains a rugged mountain and desert region covering about 2,44,000 sq. miles, which is roughly one-twelfth of the total area of the country. Like many rivers in India, it has alternated in a vicious cycle of flood and draught, wiping out millions of acres of crop some years and abandoning them to the scorching sun in others. To hundreds of thousands of people who lived directly under its threat this treacherous river was for a long time a symbol of the God of Destruction. It was in 1928 that the United States Government resolved to harness the aid of science to put this river in its proper course and the Congress authorised the project for the construction of a dam of colossal dimensions astride the Black Canyon where the Colorado river constitutes a boundary between the States of Arizona and Avada. The chief object of these engineering operations was to first control the floods and to build a reservoir of water for domestic use and irrigation and to generate power at low cost. The work was completed within five years, between 1930-1935, two years ahead of the scheduled time. The total cost was 165 million dollars. Some of the remarkable features of the project were: Construction of four immense bunds through the Canyon walls, diverting the river from its course, building two huge coffer dams, blasting out the dam site and fabricating the dam and power plant in solid blocks of concrete. In this operation they used 4,40,000 cubic yards of masonry; 50 lac barrels of cement; 80 lac tons of sand, gravel and cobblestones; 6 crore 30 lacs tons of structural and reinforcing steel; 2 crore 10 lacs pounds of gates and walls; and 840 miles of pipe.

To-day, the Boulder Dam stands as one of the greatest feats of engineering and a monument of the vision of the United States of America. Towering 726 feet above the river bed, stretching 1,240 feet from the water wall, measuring 660 feet at its base, it runs the world's' highest tank. During the eight years of its existence Boulder Dam has altered the face and made the fortunes of the South-Western States in the U.S.A. It irrigates 20 lacs of acres of farm land in South California, Arizona and Avada. The power plant produces 30 lac kW of cheap power which has lit dozens of cities and brought comfort and prosperity to large areas in that locality. Similar and more important developments have been made in the well-known T.V.A. regions.

Coming to Canada we felt that this great dominion of British Empire shares with America the feeling that once science and technology are properly developed, poverty will vanish by itself. As a matter of practical example, the Canadian Government have brought into being under the National Research Council of Canada, an organisation called the Research Enterprises, Ltd., whose function is to develop on a large scale the discoveries that have been made by the Council during the war. The motto of this organisation is "What is difficult we do just now. What is impossible we take sometime to do." Within the last four years the Canadians have done wonderfully well in every phase of activity. In a nutshell, Canada is trying to follow in the footsteps of America. The feeling in that country is that politics ought to be relegated to a minor position and more attention should be paid to developments. This may or may not apply equally vigorously to India; there is no doubt that science has never been tried by the people or by the Government on a large enough scale to banish poverty from this land.

Finally, I must say that in America we found a great deal of desire on the part of Americans to develop weaker nations and that desire is equally shared in Great Britain and the recent announcement of Lord Nuffield with respect to motor car industry in India may be cited as an example. The U.S.A. have already invited a large number of Chinese students to that country and have awarded scholarships to train them as scientists and technicians to take up the problem of industrial development of China. A complete programme of Chinese development, if catalogued, will run up to some 550 pages. Unless we plan and develop in a really big way both in agriculture and industry, there is no future for us, and we shall never be able to have our proper place in the comity of nations.

TIME, SPACE AND THE MENTAL MACHINE

PROF. W. BURRIDGE, D.M., M.A. (Oxon.), F.N.I.
(Department of Physiology, King George's Medical College, Lucknow)

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SOME years ago as a result of putting together a large number of results obtained by me through stimulating beating hearts with adrenaline I discovered a new law of natural stimulation which reads as follows:—"In living structures their natural stimulation according to its strength causes a corresponding development of energy which first remains in being and then dissipates after the stimulant has ceased to act."[4] But, after discovering that law as the result of stimulating living structures, I found that my motor car and bicycle obeyed it. So do all other inanimate structures which move on the face of this earth as the result of impressed force. And since these inanimate objects obey this law because of friction, I deduced that living structures obeyed it likewise. That is to say, the natural stimulation of living tissues gives rise to increased movements of structures with surfaces.[3]

This law can be verified physiologically by the non-physiologist through his vision. He already takes it for granted that the energy developed within him as a sensation has some accordance with the strength of the stimulant, which is light. He probably knows that the cinema depends on the capacity of the sensation-energy developed thereby first to remain in being after the stimulant has ceased to act. Thereafter it dissipates. To verify the law with a motor car one simply puts the 'phenomena' of motoring into the terminology of physiology.[3]

Now it is typical of the reaction of a living tissue to stimulation that the energy of discharge is out of all proportion to the energy used in stimulation. This 'property', it may be observed, is possessed by motor cars wherein the energy of stimulation, as pressure on the accelerator pedal, is out of all proportion to the energy discharge or momentum thereby developed by the car. There is, therefore, no question of the stimulating agent supplying energy by its own oxidation. Moreover, sodium chloride is a stimulating agent,[1] and it is certainly not combustible even by living tissues. I have consequently to seek self-propelled bodies as the units which move faster when living tissues are stimulated to increased activity, or increased capacity for function.

So far as the agency of propulsion is concerned, I have got down to structures at the most of the size of a colloidal particle, and that rules out all organised propulsive agents such as flagella, etc. In fact, one is only left with surface tension, the probable source of movement of the amœba. This is a perfectly feasible agent of propulsion, and to utilise it we require units which can oxidise foodstuffs, and in doing so, give rise to metabolic products which can alter surface tension. It is further feasible that Nature should have evolved a unit which produced two classes of metabolic products. The one class should ooze out over the unit's front half and lower surface tension, the other class should ooze out over the posterior half and raise it.

When I first discovered that friction is concerned with natural stimulation then, in view of the overwhelming evidence that colloids have determining roles in excitation processes, I sought in the movement of colloidal particles, because they have surfaces, the source of that friction.[3] Considering also that there is law and order in a beating heart in that it regularly undergoes a cycle of operations comprised of contraction, relaxation, and rest, I visualised something corresponding to this in movements. I, therefore, suggested that these colloids had regulated movements corresponding to those of a body of troops performing drill on a barrack square, as opposed to the 'Brownian' movements of a crowd disporting itself over the same area.[3]

To regulate these movements, however, requires something of the nature of a commanding force to enforce the regulating. One required also something corresponding to change of direction to explain alternations of state corresponding with alternation of contraction and relaxation. But it was also the case that a change of direction, provided movements were in straight lines, required still another force to change the direction. On the other hand, if there were not changes of direction, the setting up of a high state of functional capacity, as such movements in one part of a nerve, say, should automatically be succeeded by a loss of functional capacity in that part, and such is definitely not the case. Moreover, the restriction of travel of these moving elements cannot be brought about by walled boundaries, because a single collision between moving particles in such a confined space would eventually confer on living matter the properties of a gas. Motion in orbits, thus, emerges by exclusion as the nature of these regulated, restricted movements.

Having deduced that, one can straightway consider whether the conclusion is probable, and I consider that the answer to this is yes. At any rate, it seems to me more likely that Nature has a fundamental plan of construction than several. Biologists, however, have no more suspected that living matter is built up on the lines of the solar system any more than physicists and chemists originally suspected that the atom was. Yet, such a structure is the only one that can supply an answer to that obedience of living tissues to Burridge's Law. The protoplasmic atom is one where the satellites move in a medium subjecting them to friction, and Nature conferred what we term life on that system when the satellites were made self-propelled.

We have next to observe that a self-propelled circular body subjected to friction will not keep its orbit, because the outer edge will move faster than the inner and the differences of friction will provide a rotational force. In turn, this will change the direction of propulsion, and so the satellite will move out of its orbit. The actual form of satellite that would tend to keep its orbit in a frictional medium, I leave to the mathematicians to work out. For the present it suffices to rule out circular bodies because that rules out colloidal partj-

cles as the satellites. But, as already mentioned, the evidence that colloids have determining roles in excitation processes is overwhelming. I, therefore, assign to a charged colloidal aggregate the functions of a nucleus.

A colloidal aggregate is capable of reacting in two ways to what physiologists would term a change of environment and what the physical chemist will term a change in the composition of the dispersing phase; it can react either through adsorption phenomena or through changes of colloidal aggregation, or, and more probably, by both. In my book, *Excitability*,[1] I have summed up an abundance of evidence that living tissues do react to an environmental change in such manners as had the marks of an absorption reaction and a change of aggregation, respectively. My findings further indicated that changes of colloidal aggregation and adsorption reactions were the sources of energy for the excitation processes of living structures. There was, however, a significant difference following on change of the composition of the dispersing phase *in vivo* and a change *in vitro* in that with the former there were marked changes in the energy manifestations of the system. An orbital system explains those differences.

According to other work done by me, calcium is the exciting agent of the cardiac exciting apparatus; also, when it does excite, it exercises a coagulative change in the colloids concerned in excitation processes.[1] Earlier work by Macdonald,[5] however, showed that these colloids have abundance of potassium salts adsorbed on them, and that the shedding of these potassium salts into the dispersing phase automatically causes re-dispersion of the colloidal aggregates. That is to say, the nucleus of the living solar system is capable of undergoing alternations of neutralisation and re-charging. At the same time it should be observed that calcium does not appear to be the neutralising agent in all excitable tissues. Nicotine is the agent which reveals where calcium acts as the neutraliser, and it provides the evidence that something other than calcium neutralises in the nerve trunk.[1]

Neutralisation of the nucleus of this physiological atom will be followed by disruption of that particular atom, the satellites of which will fly off in all directions, and, since they hold charges opposite in sign to the nuclei, they can be expected to be drawn towards and exert a neutralising action on neighbouring nuclei. That is to say, all neighbouring systems should undergo neutralisation and disruption. This is another way of stating that an excitation should be conveyed in all directions, and it is. We have to note, however, that if the structural conformation of any satellite helps it to keep to a particular orbit, it will not travel in straight lines after nuclear neutralisation, but some wider orbit determined by its own proper configuration and propulsive force.

From this point of view the propagation of the nerve impulse along a nerve is to be visualised as a wave of advancing disruption of physiological atoms followed by their restitution in the rear. We may well indeed find some day that the wider orbit made possible to a satellite by a nuclear neutralisation does not extend beyond one or two atoms, and that it may tend automatically to return to its old orbit as the nucleus recovers its charge. In any case, with all atoms being disrupted and all being reconstituted, any atom should on an average recover as much as it originally lost.

Another point to note about these systems is that adsorption phenomena and aggregation changes taking place at the nucleus are both expressed as changed motion or momentum of the satellites. That is to say, we ought to be able to obtain some evidence that both of these changes ultimately appear to be the same thing. There is evidence to that effect, but before considering it the reader's attention is drawn to certain psychological aphorisms given by me elsewhere. Those aphorisms are:

(1) We do not know what things are, we only know what we believe them to be.

(2) What we believe a thing to be is determined for each of us by the nature of the processes working in our organs of mind and thereby mediating that belief to us.

(3) We are born to believe in the existence of external realities corresponding to the processes at work in our organs of mind, but things are not necessarily so.

Applying these aphorisms to the case of the drunk man, we appreciate that he is drunk because he must believe as faithfully in the results of the altered working of his mental machinery produced by a drug as he did in its normal workings when sober. Likewise, the insane man is insane because he cannot help believing in the truth of what abnormal working of his mental machinery appears to him to reveal.

It is not, however, the habit of men to reflect on the fact that Nature has provided them with a definite type of machinery wherewith to do their thinking, and that in consequence the machinery must be a factor determining what is produced from the facts which are put into it. So far as I can judge, philosophers and mathematicians are the men who have probed most deeply into the workings of this mental machinery. The former have reached the conception that the great realities of nature are time and space. In my book, *A New Physiological Psychology*,[2] however, I have pointed out that our conception of time as a great reality is based on adsorption reactions taking place in the nerve cells of our brains, whereas the conception of space is based on changes of colloidal aggregation taking place in those same colloidal systems which form the machinery for our thinking. I have consequently pointed out that there may be other great realities about which we can gain no conception simply because we have not got the thinking machinery which makes this possible. We should, therefore, be prudent in our negations. Even the importance which scientists are wont to attach to comprehensive theories is an automatic consequence of the mental machinery working as it does.[2]

According to these findings, then, the philosophers have looked outside themselves for external realities corresponding to the capacities of the nuclei of our physiological atoms. The mathematicians have done the same with-

out taking into consideration the point that the machinery with which they do their calculating is a factor determining the products or proofs at which they eventually arrive. Considering also that the seeming importance of comprehensive theories is automatically derived from the nature of this machinery,[2] it seems likely that this machinery will more likely mislead us in the realm of higher mathematics than in ordinary arithmetic, though even in respect of the latter very little deviation from the normal is required to render the machinery incapable of calculating the correct change from a five-rupee note. But what it does then calculate is believed to be the truth! In contrast with this, the existence of lightning calculators, could be held to indicate that the normal machinery is a slow-motion affair.

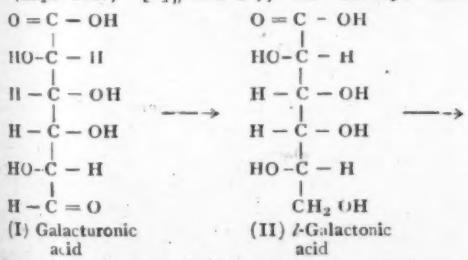
A whole volume, in fact, could be written relative to the part played by the mental machinery in arriving at a mathematical result. It is enough, however, to observe here that the machinery does play a part. We have to observe further that the events taking place in the physiological nucleus are eventually expressed in the one form of altered momentum of satellites. It seems to me, therefore, that the machinery is also built as to lead its possessor eventually to 'discover' that time and space are one. Which point being noted, the reader is left to ponder over the possibility that the modern doctrine of relativity may illustrate the much more ancient Hindu doctrine of Maya.

1. Burridge, *Excitability, Oxf. Univ. Press*, 1932. 2. —, *A New Physiological Psychology, Arnold*, 1934. 3. —, *Proc. Ind. Sci. Cong.*, 1936. 4. —, *Arch Internal de Pharmacod*, 1938, **59**, 450. 5. Macdonald, *Quart. J. Exp. Physiol.*, 1909, **2**, 65.

SYNTHESIS OF VITAMIN C FROM PECTIC SUBSTANCES

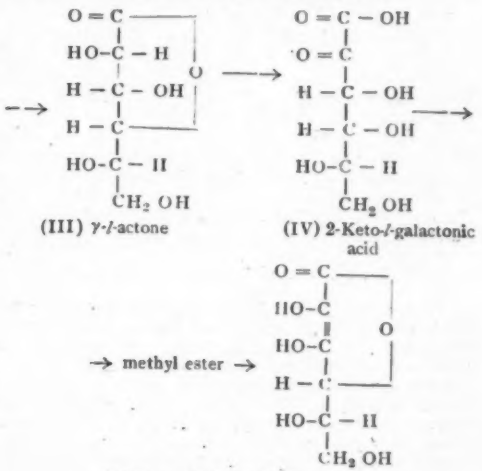
THE present requirement of vitamin C or *l*-ascorbic acid (V) is met by isolating the substance from fresh fruits and vegetables or preparing it synthetically from sorbitol. A new and a comparatively easier process for the preparation of vitamin C from pectic substances like beet-pulp has recently[1] been developed. The pectic substance is hydrolysed with a commercial pectinase and the resulting galacturonic acid (I) is separated in the form of a difficultly soluble calcium or strontium salt (15-20 per cent. yield). This salt is almost quantitatively reduced with Raney nickel and hydrogen under pressure and the resulting salt of L-galactonic acid (II) is converted by subsequent treatment with oxalic acid to the corresponding γ-lactone (III) (m.p. 134°, $[\alpha]_D^{20} = 78°$) in over 90 per cent. yield. The above lactone is then oxidised in presence of sodium chlorate and vanadium pentoxide to 2-keto-L-galactonic acid (IV) (m.p. 170°; $[\alpha]_D^{20}$ + 5·2°; 25-30 per cent. yield), which by usual treatment with anhydrous methyl alcohol and hydrogen chloride produces the methyl ester (m.p. 145-150°, $[\alpha]_D^{20} = +4·7°$, over 90 per cent. yield); when the latter substance is treated with alcoholic sodium methylate and subsequently ecidified with N-sulphuric acid, it is lactonised and enolised to L-ascorbic acid (vitamin C) (V), identical with the natural product.

The preparations of 2-keto-D-galactonic acid (m.p. 170°, $[\alpha]_D^{20} = 5·2°$), its methyl ester



(I) Galacturonic acid — (II) *l*-Galactonic acid

1. Isabell, H, S., *J. Research NBS*, 1944, **33**, 45.



(III) γ-*l*-actone — (IV) 2-Keto-*l*-galactonic acid

(V) L-ascorbic acid (Vitamin C)

(m.p. 145-150°, $[\alpha]_D^{20} = -4·6°$ and D-ascorbic acid (m.p. 191°, $[\alpha]_D^{20} = -23·8$) have also been described in this paper.

It is very interesting to note that 2-keto-L-galactonic acid (IV) and its methyl ester on lactonisation and enolisation yield natural ascorbic acid rather than an isomer thereof.

Many of the reactions of this paper and also the formation of furfural and reductic acid from pentoses and heuronic acids have been interpreted in terms of electronic displacement.

The main importance of the paper lies in the fact that it opens a vast possibility for the utilisation of beet-pulp, obtained from sugar industry, as an easily available raw material for the manufacture of vitamin C. If the yield in the oxidation of L-galactono-Y-lactone (III) to 2-keto-L-galactonic acid (IV) is improved, the process will compare favourably with the sorbose process, now utilised for the synthetic production of this important compound.

S. C. B.

LETTERS TO THE EDITOR

THE LIGHT-EFFECT UNDER ELECTRIC DISCHARGE: THE PROBABILITY OF RECOMBINATION

IT has been found by Joshi and others[1] that the conductivity of gases like chlorine when subjected to ionisation by collision under alternating electric fields, diminishes immediately on irradiation. This seems to be a contradiction to the Photo-electric effect in gases and hence it appears to be of the nature of a negative photo-effect.

Without entering into the detailed mechanism of this light-effect, it may be suggested that the familiar photo-electric effect should occur immediately after irradiation. It should not be overlooked that the photo-electric effect in gases becomes complicated due to the fact that the photoelectrons from the walls of any apparatus used are greater in number than those from the gas itself. The shielding of the metal electrodes used for determining the conductivity of the gas is also an important factor. Under such circumstances there should be a net increase in the conductivity due to the photo-electric effect in the gas, the wall effect and the electrode effect. The decrease in conductivity on irradiation suggests that there is probably some mechanism by which a recombination of the ions is taking place on irradiation. It should be remembered that the gas is being subjected to electrical discharge under an alternating field which is most likely effective in increasing the recombination of the ions and the electrons.

It is obvious that the ions and the electrons have to change the directions of their motion in the alternating field and they are continuously colliding with each other at a pressure of 46·5 cm. when the light-effect is reported to be a maximum.[2] The velocity of the ions and the electrons is continuously varying from zero to a definite maximum depending upon the mean free path and the magnitude of the electric field impressed. It has been found that electrons of a definite velocity find the collisional areas of molecules of the gas to be higher than those expected from gas kinetic consideration.[3] Under this increased collisional areas of molecules and the optimum value of pressure of 46·5 cm., the probability of recombination might increase due to the collisions in the alternating field.

The collisions are of the first kind before irradiation where the internal energy of the atom is raised at the expense of the relative translational energy of the collisional partners. The effect of irradiation might be the ionisation of gaseous molecule without dissociation or dissociation of molecule and ionisation of one of its atoms or ionisation of the gaseous atom. After irradiation the collisions are predominantly of the second kind where an excited atom collides with an electron and the latter is raised to a higher energy state and the former loses energy. In an alternating field, the electrons and the excited atoms are moving in opposite directions and in a collision of the second kind under such conditions, the velocity of the electron is decreased instead of increasing. After a certain time depending on the frequency of the alternating field, the electron is subjected to a retardation due to the reversal of the field and its velocity becomes zero. As the initial velocity decreases

due to the collision, the distance the electron would traverse when its velocity becomes zero, also decreases under the retarding field. The decrease in this distance means an increase in the number of times when the velocity of the electron tends to become zero. Since the probability of ionisation by a light quantum is a maximum when its energy just exceeds the ionising potential so that the kinetic energy of the photoelectrons is small, it follows from the principle of microscopic reversibility[4] that the probability of combination is greatest when a slow electron collides with an ion. Under such circumstances, the probability of recombination is increased due to the excess of the electrons approaching a velocity equal to zero and hence there might be a diminution of the discharge current in an alternating field on irradiation.

Whatever might be the true mechanism of this decrease in current on irradiation, it may be emphasised that this light-effect has got several technical promises and applications in the future.

The author is highly indebted to Dr. S. S. Joshi for kindly sending the reprints and the relevant information on the subject.

St. Xavier's College,
Ranchi, B. K. SAHAY.
March 25, 1945.

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1. Joshi and Narasimhan, *Curr. Sci.*, 1940, **9**, 536; — and Deshmukh, *Nature*, 1941, **147**, 806; —, *Proc, Indian Sci. Cong.*, Presidential Address, Chem. Sec., 1943. 2. — and Deo, *Nature*, 1944, **153**, 414. 3. Brode, *Phys. Rev.*, 1924, **23**, 664; —. *Ibid.*, 1925, **25**, 636; —, *Proc. Roy. Soc.*, 1926, **109**, 397. 4. Klein and Rosseland, *Z. Physik.*, 1921, **4**, 46.

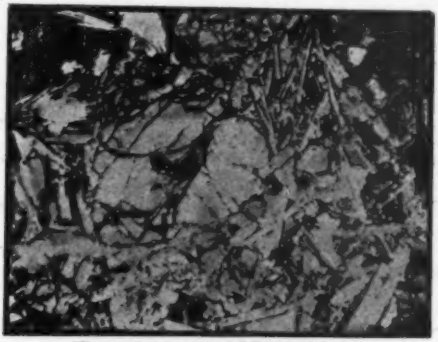
ON AN OCCURRENCE OF MICA-PERIDOTITE FROM MIRZAPUR DISTRICT, UNITED PROVINCES

THIS note describes the occurrence of a very small and narrow dyke of Mica-peridotite east of Chhipia village which has not been previously recorded. It is probably the westernmost occurrence of mica-peridotites, the known occurrences being more to the east in the Giridih, Jharia and Raniganj coalfields.

The rock is medium-grained, and black in colour with glistening flakes of deep brown biotite. Greenish black grains of olivine altered to serpentine can also be seen. It effervesces with warm concentrated hydrochloric acid indicating the presence of dolomite. The specific gravity of the rock is 2·97.

Under the microscope, the grains of olivine are somewhat rounded, crystal boundaries being observed only in a few cases. The length of the crystals varies between 1·61 mm. and ·53 mm., the average being ·99 mm. Almost all the sections show serpentinisation, with liberation of magnetite sometimes along the cracks. In some cases, the serpentine is further altered to a mineral resembling talc. Ultimately, however, it is seen to be replaced by a fine-grained mosaic of dolomite.

Biotite is remarkably fresh and is strongly pleochroic from light yellowish brown to dark brown. Its flakes enclose grains of olivine giving an ophitic aspect. The flakes vary in



Photomicrograph of Mica-peridotite
Ordinary light × 31·25

length from ·26 mm. to 1·54 mm. In some instances bleaching of the interior is marked.

Augite which is subordinate in amount, is pale-green in colour and has an elongated form. A few small stout prismatic sections of common hornblende are observed. It also occurs in small greenish patches derived by the alteration of augite.

Magnetite occurs associated with serpentine, as inclusions in biotite, and in the form of dendritic skeletal crystals. But the inclusions of this mineral in biotite have well-developed outline. Ilmenite is much less common and is seen altered to leucoxene. Hæmatite and limonite occur as small specks.

The study of the rock has been made under the guidance of Dr. H. L. Chhibber, Department of Geology, University of Lucknow. To him the writer is highly indebted.

Department of Geology,
Lucknow University, R. C. MISRA.
February 15, 1945.

NEGATIVELY CHARGED FERRIC VANADATE SOL

WHEREAS the positively charged sols of ferric arsenate, phosphate, molybdate, tungstate and borate have been prepared and studied by Grimaux,[1] Holmes,[2] Dhar,[3] Prakash,[4] and Ghosh,[5] no attempt has been made to prepare and investigate their negatively charged sols. In a paper Prakash and Mushran[6] investigated the detailed conditions under which these negatively charged sols can be obtained in this note the results with negatively charged ferric vanadate sol have been recorded.

When ammonium vanadate, is added to ferric chloride solution, yellowish white precipitate of ferric vanadate is obtained. It is observed that the precipitated ferric vanadate can be dispersed by caustic soda in presence of glucose or glycerine to yield a clear deep

red sol. If the sol is dialysed until all electrolytes are removed it can be shown to possess a negative charge. By taking the sol in a U-tube with platinum electrodes, and passing a current, it is seen that the sol is coagulated at the anode. The coagulum after being collected and washed is found to contain ferric vanadate. The idea of peptisation can be had from the following figures:—

1·0 to 2·5 c.c. of a ferric chloride solution (corresponding to 30·36 gms. or Fe_2O_3 per litre) when mixed with 1·0 to 3·0 c.c. of ammonium vanadate solution (corresponding to 6·5485 gms. of V_2O_5 per litre) in presence of 0·9 to 3·0 c.c. of 20 per cent. glucose solution requires 1·3 to 4·0 c.c. of N-NaOH (total volume 10 c.c.) to bring about the complete peptisation in half an hour.

1·0 to 2·5 c.c. of a ferric chloride solution (of the same strength) when mixed with 1 to 3 c.c. of ammonium vanadate (of the same strength) in presence of 0·4 to 2·5 c.c. of glycerine requires 1·4 to 3·4 c.c. of N-NaOH (total volume 10 c.c.) to bring about the complete peptisation in half an hour.

Detailed procedure of the study of this sol will be duly communicated.

The auhor is greatly indebted to Dr. Satya Prakash for suggesting the problem and for guidance during the course of this work.

Chemical Research Lab.,
Allahabad University, S. P. MUSHRAN.
April 24, 1945.

1. Grimaux, *Comptes Rend.*, 1884, **98**, 1540. 2. Holmes *J. Amer. Chem. Soc.* 1918, **40**, 1014. 3. Dhar and Prakash, *J. Indian Chem. Soc.*, 1930, **7**, 367. 4. Prakash and Verma, *Z. Anorg. Chem.*, 1932, **205**, 241. 5. Ghosh and Chakravarti, *Proc. Nat. Acad. Sci.*, 1939, **9**, 201. 6. Prakash and Mushran, *Allahabad Univ. Studies*, 1943, **19**, 1.

VERNALISATION RESPONSE OF INDIAN WHEATS

THE six different strains of foreign wheats so far tried by us in Almora since 1938—Holdfast, Little Joss, Yeoman, Juliana and Yorkwin—have all given significant vernalisation response, i.e., earlier emergence of inflorescence in plants from pre-chilled seeds. In both Holdfast and Yeoman[1] a maximum earliness of nearly one month has been observed in normal seasonal sowings of October. A few strains of Indian wheat which have hitherto been tried for vernalisation experiments in different places in India are: Bansi 103, in Poona,[2] I.P. 4, I.P. 114 and C. 13, in Almora,[3] I.P. 114 and I.P. 165, in New Delhi,[4] and I.P.4, I.P. 52 and I.P. 165 in Calcutta.[5] The observed earliness in ear emergence of plants from vernalised seeds in all these wheats, if any, was very slight and statistically insignificant. These observations led to the general acceptance that the cultlivated strains of Indian wheat would not respond to vernalisation on account of their shorter life-cycles.

The results (unpublished) of our vernalisation experiments with crosses between I.P. 4 (Indian wheat) and Yeoman (Cambridge winter wheat), begun in 1939 and still in progress, proved that F_1, F_2 crosses and F_3 selections, all with a much shorter life-cycle than their Yeoman parent, gave very good vernalisation response. This encouraged the hope that there might be some cultivated Indian wheats, after all, which would respond to vernalisation. In 1942, first preliminary experiments were undertaken with 18 pure strains of cultivated Indian wheats—P.3-A, P.9-D, P.499, P.C. 518, P.C. 591, C.Ph. 47, A.T. 38, H.S.W. 3, I.P. 12, I.P. 52, I.P. 80-5, I.P. 101, I.P. 111, I.P. 114, I.P. 120, I.P. 125, I.P. 165 and C. 13—seeds of which were obtained through the courtesy of Dr. B. P. Pal, Imperial Economic Botanist, from his collection at New Delhi. As a result of the encouraging results observed in 1942-43, we (*i*) repeated the experiments with these eighteen strains in 1943-44, and (*ii*) arranged a systematic study, in co-operation with Dr. B. P. Pal, of the vernalisation response of all the available strains of Indian wheats in his collection.

In 1943-44, two sowings were made of vernalised seeds of the eighteen strains listed—one in October 1943, and the other in February 1944. For both these sowings the seeds were chilled for 67 days and were sown with their corresponding controls in similar stages of germination in randomised blocks with four replications. The data of the vernalisation response of the strains of the cultivated Indian wheat in which a significant earliness of over one week was observed in normal seasonal sowings of October, together with their responses in February sowings, for comparison, are given in Table I.

From the above table it will be seen that (*a*) there are strains of cultivated Indian wheat which respond to vernalisation, (*b*) response of different strains varies and (*c*) an earliness in ear emergence up to 27·5 days can be obtained in plants from vernalised seeds of P. 9-D, in normal seasonal sowing in this region. The comparison of the earliness observed in October and February sowings clearly indicates that favourable after-sowing environmental factors—temperature and daily light period—modify, and in some cases, even completely mask, the advantages of pre-chilling of seeds. For instance, (*i*) the earliness observed in P. 9-D and A.T. 38 in October sowing was 27·5 and 20·5 days respectively, while the corresponding earliness in February sowing was 2·68 and 2·50 days, and (*ii*) in February sowing of the other seven strains, no significant earliness could be observed, even in P. 8-A, which in October sowing showed a significant earliness of 19·75 days. Therefore, to explore the practical possibilities of vernalisation for Indian agriculture it would be necessary to observe the vernalisation response of different strains of crops when grown in different climatic regions of India.

Though an earliness of agricultural significance in ear emergence of certain cultivated Indian wheats can be obtained by the use of vernalised seeds, it will be seen from Table II that the number of tillers, the factor positively correlated with yield, observed in both sowings in plants from vernalised seeds, was smaller.

TABLE I

Showing vernalisation response of cultivated Indian wheats, sown (I) October 1943, (II) in February 1944, (C) control plants; (V) plant from vernalised seeds. The number of plants are given in brackets

Strain	Mean number of days for ear emergence				Earliness (days) in ear emergence in (V)	
	I		II			
	(C)	(V)	(C)	(V)	(I)	(II)
P. 8—A	140·50 (33)	120·75 (32)	69·89 (19)	67·78 (19)	19·75*	2·11
P. 9—D	130·00 (34)	102·50 (32)	66·68 (19)	64·00 (18)	27·50‡	2·68†
P. C. 499	124·50 (36)	111·25 (35)	..	..	13·25†	..
P. C. 518	122·75 (37)	115·00 (37)	67·15 (19)	67·46 (15)	7·75*	−0·31
P. C. 591	124·50 (35)	109·75 (37)	67·60 (20)	65·05 (18)	14·75†	0·55
C. Ph. 47	114·25 (39)	94·75 (39)	68·88 (18)	68·94 (16)	19·50*	0·60
A. T. 38	142·75 (37)	122·25 (34)	70·40 (18)	67·90 (15)	20·50‡	2·50*
H. S. W. 3	135·50 (37)	121·50 (36)	71·16 (18)	71·70 (17)	14·00†	0·54
I. P. 12	108·75 (37)	99·00 (38)	69·00 (12)	67·60 (13)	9·75‡	−1·60

* Significant at 5 % level, † At 1 % level and ‡ At 0·1 % level.

TABLE II

Showing number of tillers in plants from control (C), and vernalised (V) seeds. (I) October 1943 sowing, and (II) February 1944 sowing. Number of plants is given in brackets.

Strain	Mean number of tillers			
	I		II	
	(C)	(V)	(C)	(V)
P. 8—A	13·9 (33)	6·3 (32)	7·3 (19)	5·9 (19)
P. 9—D	13·0 (34)	6·6 (32)	5·3 (19)	4·4 (18)
P. C. 499	6·9 (36)	4·5 (35)	..	..
P. C. 518	7·8 (37)	6·0 (37)	6·3 (19)	5·4 (15)
P. C. 591	8·0 (35)	5·6 (37)	7·0 (20)	5·3 (18)
C. Ph. 47	11·0 (39)	7·4 (39)	3·5 (18)	2·6 (16)
A. T. 38	12·9 (37)	6·6 (34)	3·7 (18)	3·3 (15)
H. S. W. 3	15·8 (37)	9·4 (36)	5·0 (18)	4·0 (17)
I. P. 12	10·8 (37)	7·8 (38)	6·5 (12)	4·2 (13)

In view of the observed diminished number of tillers in plants from vernalised seeds, spacing experiments with control and vernalised seeds of P. 9-D, A.T. 38 and P. 591 have now been undertaken in 1944-45, to find out whether by closer spacing similar, if not higher, yield can be obtained by the use of vernalised seeds.

Regarding the systematic study of the vernalisation response of all available strains of Indian wheat, one hundred and fifty strains were vernalised in a Frost Pit[6] in Almora, in 1943-44. An off-season sowing of these seeds was undertaken simultaneously in Almora and New Delhi in February 1944, and a seasonal sowing in October 1944 at both places. The report of vernalisation response of these strains will form the subject of a joint paper with Dr. B. P. Pal, when the data of October sowings become available.

We are obliged to Mr. K. Kishen, Statistician, Department of Agriculture, U.P., for the analysis of the data. The expenses of this investigation have been met from grants received from the Elmgrant Trust, Dartington, England, and the Imperial Council of Agricultural Research, New Delhi.

Vivekananda Laboratory,
Almora, U.P., B. SEN.
January 21, 1945. S. C. CHAKRAVARTI.

1. *Indian Farming*, 1940, **1**, 55–56. 2, 3 & 4. *Proc. Third Meeting Crops and Soils Wing, I.C.A.R.*, 1940, pp. 111–41. 5. *Trans. Bose Institute*, 1942–43, **15**, 105–25. 6. *Progress Report, I.C.A.R.*, 1942–43,

STABLE ADRENALINE SOLUTION

VARIOUS attempts have been made to stabilise a 0·1 per cent. solution of adrenaline hydrochloride.[1,2] Metabisulphite,[3,4] ascorbic acid,[5,6] glutathione,[7] methylene blue,[8] tryptophan,[9] guanidine,[10] one or other acid[11,12,13,14] has been incorporated into its solution. This prevents the formation of a colour and/or a precipitate[15,16] on storage. Preparation of an adrenaline solution in presence of an inert atmosphere, has no special advantage.[17] The adjustment[3,18] of pH of the final solution, and its maintenance undoubtedly increase[1] the keeping properties but does not secure stability on long storage in the tropics.

But as adrenaline used for therapeutical purpose, is a lævo-rotatory compound and as its other enantiomorphous forms are much less active in pressor action, a change in the rotatory power might also play a part in its inactivation on storage. Haddock[19] noted that at pH 1·4 to 3·7 racemisation was negligible. But working in this direction it has, however, been noticed by us that an adrenaline solution undergoes a definite change in its rotatory power at room temperature (25-30° C.) under conditions even when no change in pH and colour, nor, any formation of precipitate due to adrenochrome[15,16] has taken place. On ascertaining the strength of adrenaline in the solution by the Folin method no loss is being noticed whereas on assaying the same by the usual biological process on SPINAL cat, the solution is found to be much less potent in pressor activity. A similar phenomenon is being noticed with solutions from adrenaline salts of d-tartaric, dl-tartaric, d-camphoric, cinnamic and coumarin 3-carboxylic acids. In cases where, however, a solution has been obtained by dissolving adrenaline in presence of Lævo-acid, such as L-malic, L-mandelic, L-camphoric and L-valeric acids, no such loss in pressor activity was noticed. The solution remains stable in other respects.

The solution would be much more stable particularly when prepared in presence of carbon-dioxide and stored in dark place.

The work is based on a pending patent application.

U. P. BASU.
S. K. GANGULI.
A. N. BOSE.

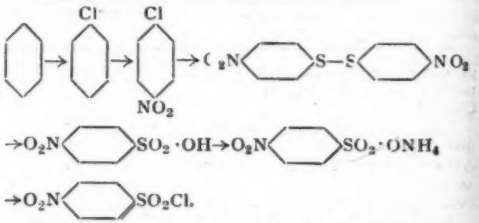
Bengal Immunity Research Lab.,
Calcutta, India,
1944.

1. Rowlinson, and Underhill, Quart. *J. Pharm. Pharmacol.*, 1939, **12**, 392. 2. Bose, Dutt and Mukherji, *Curr. Sci.*, 1942, **11**, 435. 3. Sjögren and Larsson, *Farm. Revy.*, 1936, **35**, 309. 4. Louis Julien, *J. Pharm. Chem*, 1935, **22**, 53. 5. Heard and Welch, *Biochem. Jour.*, 1935, **29**, 998. 6. Donatelli, *Chem. Abs.*, 1940, **34**, 588. 7. Welch, *Amer. J. Physiol.*, 1934, **108**, 360. 8. Nordmark-Werke, *D.R.P.*, 646561. 9. Sakuo Nomura, *Chem. Abs.*, 1938, **32**, 657. 10. Burns and Secker, *Jour., Physiol.*, 1936 **88**, 21. 11. Gunn and Harrison, *Pharm. Jour.*, 1908, **26**, 513. 12. Richard and Malmy, *J. Pharm. Chem.*, 1921, **23**, 209. 13. Debucquet, *Ibid.*, 1922, **25**, 136. 14. *B. P.*, 440968. 15. Richter and Blaschko, *Jour. Chem. Soc.*, 1937, 601. 16. Burgel and Morrison, *Ibid.* 1943, 48. 17. Woolfe, *Quart. J. Pharm. Pharmacol.*, 1941, **14**, 234. 18. Lühr and Rietschal, *Pharm. Zentralh.*, 1938, **79**, 193; *Quart. J. Pharm. Pharmacol.*, 1938, **11**, 788. 19. Haddock, *Ibid.*, 1933, **6**, 496.

SYNTHESIS OF SOME N-SUBSTITUTED *p*-NITROBENZENESULPHONAMIDES[1]

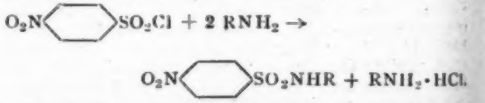
NUCLEAR disubstituted benzene compounds containing either a nitro or sulphonic acid group as one of the substituents, with the second substituent in the *p*-position, form an interesting group of related compounds from the standpoint of the Crum-Brown-Gibson Rule for aromatic substitution. It is well-known that the nitro group in nitrobenzene offers considerable steric hindrance to the introduction of a second substituent in the ring, especially in the case of the second substituent being an ortho-para directing group, the position taken by the second substituent being, of course, meta to the nitro group. The same remarks apply generally to the introduction of a second substituent in a compound like benzenesulphonamide.

The preparation, therefore, of a derivative like *p*-nitrobenzenesulphonamide, is of unusual interest as both the substituent groups are in mutually incompatible positions from the view-point of the rule quoted above. Hence, it is not surprising that the following indirect procedure has been adopted by workers in the field[2-8] to obtain the apparently simple compound, *p*-nitrobenzenesulphochloride. This being a fundamental reagent in this work, it was prepared in good quantity, following generally the method of Bell.[5]



The present paper deals with the synthesis of eight N-substituted *p*-nitrobenzenesulphonamides, outlined in the table given below. Of these the last five have been reported for the first time.

The general method adopted for their preparation was the condensation of *p*-nitrobenzenesulphochloride in aqueous alcoholic solution with two molecular proportions of the appropriate amine in the cold, avoiding thereby any extraneous condensing agent for the elimination of hydrogen chloride.



The various amines as well as the whole series of intermediate products required for

Condensation of *p*-Nitrobenzenesulphochloride with	Product obtained	Yield %	M. P. in °C.	Percentage of Nitrogen	
				Calcd.	Found
Ammonia ..	O_2N–C$_6$H$_4$–SO_2NH_2[7]	93	176	..	..
Methylamine ..	O_2N–C$_6$H$_4$–SO_2NHCH_3[7]	86	107–107·5	..	..
Ethylamine ..	O_2N–C$_6$H$_4$–$SO_2NHC_2H_5$[7]	92	103	..	..
α-Naphthylamine ..	O_2N–C$_6$H$_4$–SO_2NH–C$_{10}$H$_7$	84	196–197	8·53	8·27
β-Naphthylamine ..	O_2N–C$_6$H$_4$–SO_2NH–C$_{10}$H$_7$	95	173–174	8·53	8·38
Methylaniline ..	O_2N–C$_6$H$_4$–$SO_2N(CH_3)C_6H_5$	97	127–128	9·59	9·47
Ethylaniline ..	O_2N–C$_6$H$_4$–$SO_2N(C_2H_5)C_6H_5$	80	158	9·15	9·11
Sulphanilamide ..	O_2N–C$_6$H$_4$–SO_2NH–C$_6$H$_4$–SO_2NH_2[11]	81	215	11·76	11·30

the preparation of p-nitrobenzenesulphochloride starting from benzene, were specially prepared and purified for this work by the usual or improved methods.

The nitrogen content of the compounds prepared was estimated by the Kjeldahl method using the modifications of Jodlbauer[9] and Cope.[10]

The specific purpose for which the above nitro compounds were synthesised was to reduce them to the corresponding azo-bis compounds which will form the subject of the next communication in this series.

My thanks are due to Mr. P. Ramaswami Ayyar for valuable suggestions and guidance, and to Dr. P. C. Guha for kind interest.

Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore, (Miss) R. J. Irani.
April 6, 1945.

1. This paper forms Part II of the author's M.Sc. Thesis entitled "Studies in the Synthesis of some substituted Benzenesulphonamides", recently submitted to the University of Madras. Part I has been published in *Curr. Sci.*, 1945, **14**, 46–47. 2. Blanksma, *Rec. trav. chim.*, 1900, **19**, 111. 3. —, *Ibid.* 1901, **20**, 128. 4. Obermiller, *J. Prakt. Chem.*, 1914, **89**, 84. 5. Bell, *J. C. S.*, 1928. 2776. 6 Elgersma, *Rec. Trav. Chim*, 1929, **48**, 753. 7. Demeny., *Ibid.*, 1929, **48**, 1146. 8. Barber, *J. C. S.*, 1943, 102. 9. Jodlbauer, *J. C. S.*, Abstracts, 1886, 834. 10 Cope, *J. Ind. Eng. Chem.*, 1916, **8**, 592. 11. I. G. Farbenindustrie, *A.-G. Brit., P.*, 1939, 500, 118.

PRELIMINARY NOTE ON THE POSSIBLE USE OF PENICILLIN TO REDUCE THE NUMBER OF BACTERIA IN FRESHLY PREPARED COW-POX VACCINE (AGAINST SMALL-POX)

It is a notoriously difficult task to reduce to a minimum the associated Bacteria (the chiefly occurring ones are fungus, staphilococci and streptococci—in some cases) in the vaccines prepared against small-pox from female buffalo calves—the animal that is now usually used in laboratories for preparing small-pox vaccine lymph. The usual method adopted for sterilising vaccine lymph is to suspend the finely powdered material obtained from the animals, in glycerine and store such glycerine-suspended lymph in ice box between 5° C. and 8° C., for long periods of time (8 months to a year). Bacterial counts are taken at various intervals and when the staphylococci are reduced to a minimum—by the slow antiseptic action of glycerine—the vaccine is issued for general use.

It was thought possible to use Penicillin along with glycerine, to reduce these associated bacteria to a minimum in a short time. A Flemming culture was obtained, one each, from Mr. M. J. Narasimhan, Director of Agriculture, and Dr. Ananthaswamy, Bacteriologist, Public Health Institute, for this purpose. Preliminary experiments show a very good inhibitory—*lethal*—action by Penicillin, in glyce-

rine-suspended lymph against the staphylococci which are greatly reduced in number within 72 hours. Crude non-concentrated watery extracts of Penicillin have been used for the purpose.

It is hoped soon to publish detailed reports of experiments on the use of Penicillin for sterilising cow-pox lymph so as to shorten the time of storage.

Public Health Institute,
Bangalore, C. V. NATARAJAN.
May 2, 1945.

Post-script.—After the above note was written, it was noticed in the letter to the Editor of the *Journal of the American Medical Association*, from Brazil, wherein it is stated that Dr. C. Miranda, of the Oswaldo Cruz Institute, Rio De Janerio, has been experimenting with Penicillin on the same lines, *i.e.*, to sterilise cow-pox vaccine by Penicillin, so as to make cow-pox vaccine available for general use within a few weeks, instead of a year or longer, as obtains now.

Journal of the American Medical Association, Feb. 24, 1945, **127**, 476.

TETANISATION OF THE HEART

IT is generally believed that heart muscle cannot be tetanised. We have come across frogs, the hearts of which resembled striated and unstriated muscle, in that they were thrown into a complete tetanus by frequent stimulation with induction shocks (Fig. 1). The results obtained were similar to those in striated muscle, incomplete tetanus passing into tetanus.

Doubling the concentration of calcium in the Ringer solution prevented the tetanus, the heart responding by frequent beats instead (Fig. 2). This effect of calcium in preventing tetanus resembles that found in plain muscle (Singh, 1938). Acetylcholine had a normal effect. When the heart was brought to a complete stand still by the drug (1 in 10),

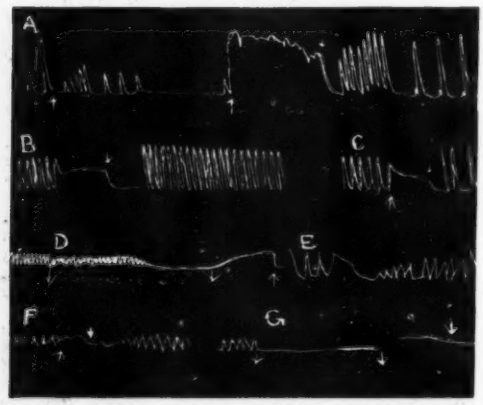


FIG. 1. *A*. Frog heart. Acetylcholine 1 in 10^9 added at first arrow. Stmulated with induction shocks from 2nd to 3rd arrow. Note the tetanus. After stimulation, the heart may be at standstill or hyperirritable. *B*. Frog heart. Note complete tetanus. After effects same as in IA. *C*. Frog heart same as IB. *D*. Effect of acetylcholine. Complete tetanus on stimulation. *E*. Same as IB. C. *F*. Frog heart, incomplete tetanus. *G*. Same heart as in F; addition of acetylcholine at first arrow. Subsequent stimulation with induction shocks. Note acetylcholine converts incomplete into complete tetanus.

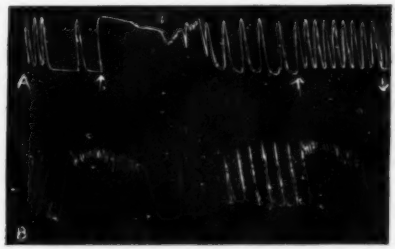


FIG. 2. Frog heart. Effect of calcium (twice normal) on tetanus. *A*. Complete tetanus. On cessation of stimulation at the 2nd arrow, the heart is still contracted. The solution now contains double the calcium content. Stimulation between 3rd and 4th arrow shows no tetanus; the heart is slightly contracted, and rate increased. *B*. Frog heart, tetanus. With adaptation the tetanus becomes more incomplete, as happens in the plain muscle. The 2nd figure shows the effect of doubling the concentration, same as in IIA. This suggests that as in the plain muscle, adaptation is due to liberation of calcium.

stimulation with repeated induction shocks produced tetanus.

INDERGIT SINGH.
K. B. SEHARA.
MRS. SUNITA INDERGIT SINGH.
Department of Physiology,
Medical College,
Hyderabad (Sind),
January 26, 1945.

1. Singh, I., *J. Physiol.*, 1938, **94**, 322.

BLOOD GROUPS AMONG THE MAKRANIS OF WESTERN KHANDESH

THE bloods of 108 Makranis ages varying from 5 to 40, all of whom were born in their present domicile, were tested by the 'tube method'. The testing sera were supplied by the Haffkine Institute, Bombay, through the Gujarat Research Society. A few cases in which doubtful reaction (W or ?) occurred were retested against anti-A serum of known titre with capacity to react with known A, B cells, made in Lucknow. The following was the result of the grouping tests.

The Makranis belong to the same racial stock as the Baluchis and a comparison of the blood groups' incidence among them with that of the Baluchis may be of interest. According to the blood group data collected from 74 Baluchis of Baluchistan by Malone and Lahiri (1927),[1] there are 47·2 per cent. O, 24·3 per

Name of group	Total number typed	Blood group percentages			Frequencies of genes			
		O	A	B	AB	r	p	q
Makrani Moslems ..	108	37·03 (40·n)	25·92 (28·n)	24·07 (26·n)	12·96 (14·n)	·632	·192	170

cent. A, 24·3 per cent. B, and 4·2 per cent. AB. It appears that the immigrant Baluchis of Akkalkua, i.e., the Makranis, have less O, similar A and B, and 9 per cent. more AB. In other words, there is a significant increase of AB at the expense of O. The total B + AB among the Baluch (Malone and Lahiri) is 28·5, while that among the Makranis is 37·03.

The Bhil blood groups are as follows:—

	O	A	B	AB
Panchmahal Bhils[2] (N·369 : Majumdar) .	37·0	27·5	26·5	9·0
Rajpipla Bhils[3] (N·136 : Majumdar) ..	38·4	24·3	28·8	8·5

There is 35·5 per cent. B + AB among the Panchmahal Bhils and 37·3 per cent. among the Rajpipla Bhils showing close approximation to the Makrani data.

We found a very high incidence of AB (18·4 per cent.) among the Tharus of Tarai, who live in an unhealthy tract rife with malaria.[4] The high incidence of AB among the Makranis living in similar malarious areas, may tell us something more than appears on the surface. Wherever we find the conditions of life hard, the toll of diseases considerable, or large-scale intermixture, the percentage of B and AB is higher than in groups otherwise situated. Has tropical conditions any selective effect on blood group distribution?

Lucknow University, D. N. MAJUMDAR.
March 12, 1945.

1. Malone, R. H., and Lahiri, M. N., "The distribution of the blood groups in certain races and castes in India," *Ind. J. Med. Res.*, 1929, **25**. 2. Majumdar, D. N., "The Blood Groups of the Bhils of Gujarat," *Curr. Sci.*, 1942, 9. 3. —, "Racial Affiliation of the Bhils of Gujarat," *J. Guj. Res. Soc.*, **6**, 4, Oct. 1944. 4. —, "The Tharus and their Blood Groups," *J. Roy. As. Soc. Bengal, Science*, 1942. Also *Nature*, September, 1944.

TAMARIND SEED 'PECTIN'

TAMARIND seed has been desecribed as a rich source of pectin, the de-husked kernel providing nearly 60 per cent. of it.[1] A re-examination of this constituent has, however, revealed interesting differences from other pectic substances of which the chief sources hitherto have been the waste cider and citrus residues. The latter consist essentially of methoxylated galacturonic acid units, with varying amounts of arabinose and galactose, presumably derived from associated araban and galactan, loosely attached.[2] Another defining characteristic of these pectins is the formation, through de-esterification, of pectic acid, a product of definite chemical composition[3] which is obtained either directly or, better, through the insoluble calcium salt[4] after hydrolysis by mild alkali followed by neutralisation with acid. In all these respects, the alcohol-insoluble fraction from the water extract of the tamarind seed meal behaves differently and is probably, therefore, not a pectin as ordinarily understood. Thus, it is free from methyl ester groups and reducing sugars. It does not give the Carre and Hayne reaction[5] characteristic of pectins although calcium and copper salts are precipitated in alkaline medium. Nor is galacturonic acid formed on hydrolysis with acids.[6]

Perhaps the most significant difference lies in the observation that the preparation, obtained according to the procedure outlined by Ghose and Krishna,[1] is invariably associated with about 15 per cent. of albuminoides, accounting for nearly half the total proteins of the seed. The proteins are not removed or even appreciably reduced on repeated dissolution in water and re-precipitation with alcohol while mild acid hydrolysis results in simultaneous degradaton, to varying degrees, of both the protein and polysaccharide constituents. The latter are also thrown out together from solution by protein precipitants such as phosphotungstic acid and tannic acid while excessive dilution with water followed preferably by overnight's standing results in the precipitation of the proteins only, an addition of six hundred volumes of water yielding a product with less than 2 per cent. of albuminoids. Prolonged digestion with proteolytic enzymes like pepsin and papain also removes most of the nitrogenous fraction.

In spite of these differences, the preparation from tamarind seed meal sets, like pectins, to a gel with the appropriate quantities of sugar and acid. Such jellies could also be obtained from the whole seed meal due obviously to the high content of its gel-setting constituent. But, quite unlike the pectins, this gelation is not hampered by hydrolysis with dilute alkalies. Again, as with low-methoxyl pectins, commonly referred to as pectinic acids or "pectin LM", gels, though somewhat pasty in consistency, are also formed in presence of low concentrations of sugar and metallic ions such as calcium[7] while, as observed by Ghose and Krishna,[1] a thick gum is formed on reaction with borax in aqueous solution.

With pectins, several workers have attempted to relate gel-forming capacity to some one factor—like degree of esterification[8] or equivalent weight.[9] The absence of methyl ester groups in tamarind seed preparation as also other recent evidence[7, 10] would, however, suggest that there is possibly little correlation between jelly strength and methoxyl content.

Pectins have the peculiarity of possessing a variable equivalent weight or degree of acidity depending upon their extent of esterification.[9] Tamarind seed meal preparation contains 20 milli-equivalents per cent. of free carboxyl groups. Whether these or the presence in it of albuminoids have any relation to its gel-setting property are being investigated as also its chemical composition through a study of its hydrolysis and oxidation products.

Department of Chemical Technology,
University of Bombay, H. R. NANJI.
Matunga Road, G. R. SAVUR.
Bombay 19. A. SREENIVASAN.
March 14, 1945.

[1] Ghose and Krishna, *Jour. Ind. Chem. Soc*, *Ind. and News Edn.*, 1942, **5**, 114. 2. Ehrlich, summarized in *Abderhalden's Handb. biol. Arbeitsmeth, Abt. XI*, 1503, 1936; Schneider and Fritschi, *Ber.*, 1936, **69B**, 2537; Hirst and Jones, *Jour. Chem. Soc.*, 1939, 452, 454. 3. Nanji, Paton and Ling, *Jour. Soc. Chem. Ind.*, 1925, **44**, 253T. 4. Schryver and Haynes, *Biochem. Jour.*, 1916, **10**, 539 ; Tutin, *Biochem. Jour.*, 1922, **16**, 704. 5. Carre and Haynes, *Ibid.*, 1922, **16**, 60. 6. Link and Dickson, *Jour. Biol. Chem.*, 1930, **86**, 491. 7. McCready, Owens and Maclay, *Food Industries*, 1944, **16**, 794, 906; also *Ind. Eng. Chem.*, 1944, **36**, 936. 8. Buston and Nanji, *Biochem. Jour.*, 1932, **26**, 2090. Hinton, *Dept. Sci. and Ind. Res. (Brit.) Food Investgns., Special Reports*, No. **48**, 1939. 9. Hinton, *Biochem. Jour.*, 1940, **34**, 1211. 10. Bennison and Norris, *Ibid.*, 1939, **33**, 1443.

USE OF EVERS' MODIFIED BELLIER'S TEST FOR DETECTION OF ADULTERATION OF SESAME OIL WITH NIGER-SEED OIL (*Khursani, Kala-til, Surguja*)

IN the course of our investigation regarding the detection of adulteration of sesame oil with various inferior edible oils in this city, we are generally confronted with admixture of sesame oil either with groundnut oil or niger-seed oil. This led us to apply successfully the Evers' modified Bellier's Test to ascertain proportion of groundnut oil adulteration in sesame oil. The same test is applied for the detection of niger-seed oil in sesame oil. The range between the turbidity temperatures of sesame oil and niger-seed oil is, however, small. The following are the results of turbidity temperatures and refractive indices at 40 C (Z.B.), corresponding to the different percentages of niger-seed oil present in sesame oil.

Approximate percentage of niger-seed oil present corresponding to temperatures of turbidity

Oil	Turbidity Temparature	Refr. Index at 40 C (Z, B)
Sesame ..	15—16	59·5—60
,, + Nigerseed—Oil 25% ..	18	60·5
,, + ,, 50% ..	19·5	61·0
,, + ,, 75% ..	21	62·0
Niger-seed Oil ..	22·5	63·0

This test supplemented with refractive index enables the analyst to ascertain whether sesame oil is adulterated with groundnut oil or niger-seed oil and also to ascertain the proportion of the adulterant, because the refractive index of groundnut oil is lower (55·5) than that of sesame oil, while refractive index of niger-seed oil is higher than that of sesame oil. Even if admixture of sesame oil with groundnut and niger-seed oils has been so manipulated that it indicates the refractive index of pure sesame oil, the turbidity temperature of such a product will be much higher than that of pure sesame oil. Thus this test is very convenient and useful for routine analysis. In this part of the Province, niger-seed oil is frequently used for adulterating sesame oil, because the former is much cheaper than the laltter.

Surat Borough Municipality,
Surat, C. M. DESAI.
February 28, 1945. A. H. PATEL.

THE UTILISATION OF SURPLUS RIVER WATER DURING THE MONSOON IN CROP PRODUCTION

DURING the monsoon Indian rivers run usually at flood levels, but owing to the maldistribution of rainfall many unirrigated areas frequently suffer extensive crop failure of the *kharif* (summer crops, such as rice, cotton, millets, pulses, maize, etc.) as well as of the *rabi* (winter crops, such as wheat, barley, gram, etc.) The cultivated area dependent on rainfall or *barani* conditions is about 161·18 million acres and is generally estimated to be about four-fifths of the total cultivated area of 208·72 million acres in India. In the unirrigated areas successful *rabi* crops such as wheat, barley, gram and other winter pulses as well as some oil-seeds depend on (*a*) adequate depth of moisture in the soil resulting from monsoon precipitation and (*b*) adequate moisture near the soil surface for seed germination at sowing time in late October or somewhat later. The failure of the winter crop in unirrigated areas may, therefore, arise from a failure of (*a*) or (*b*) or from both these causes. Failure of (*b*) means that the area cannot be sown, which means that the following winter rains will be wasted, as there will be no crop standing to utilize them. Experiments at Karnal and Delbi show that these failures can be prevented by the use of surplus river

Average yields of crops in maunds per acre (1 maund = 82 lbs.)

		Karnal			New Delhi		
		1941–42	1942–43	1943–44	1941–42	1942–43	1943–44
Wheat	Flooded ..	14·88	19·91	17·12	..	9·02	5·07
	Rainfed ..	5·45	17·41	9·92	..	9·20	2·75
Barley	Flooded ..	17·39	17·52	34·66	..	26·21	9·84
	Rainfed ..	9·94	16·60	16·52	..	22·83	12·07
Gram	Flooded ..	15·94	17·50	16·88	7·50	10·76	7·34
	Rainfed ..	0·97	14·71	13·40	3·32	10·45	3·22

water which now runs to waste in the sea. By flooding the land once only in early September, when plenty of surplus water is available, and without any further irrigations, the yields obtained during the last three years have been given in the above table.

The differences in yields are apparent in 1941-42 and 1943-44, but in 1942-43, a year of heavy monsoon rainfall (32·7 inches at Karnal and 26·9 inches at New Delhi), the differences are, as may be expected, of a lower order.

Growth of deep-rooted grasses in the grazing areas can be assured in years of deficient rainfall by the use of the surplus water which is now wasted. Canalization of the areas to use this water coupled with measures to conserve rainfall would assure the *kharif* crop completely and would result in the stabilization of *rabi* crop production on a higher level in these precarious areas.

Imperial Agricultural Research Institute, New Delhi, C. H. PARR.
April 22, 1945.

PREVENTION OF DAMAGE TO STORED POTATOES BY THE POTATO TUBER MOTH

IN *Current Science*,[1] Rahman publlished some resutls of his experments on the storage of potatoes and damage by the tuber moth, *Gnorimoschema operculella* Zell. In view of the seriousness of the tuber moth problem nearly all over India, the problem has been re-examined.

The results given by Rahman show:—

(1) marked difference in moth damage between covered and uncovered potatoes;
(2) little significant difference in damage covered by the seven materials used, either by moth or by rot;
(3) none of the seven materials used, has any superiority, in preventing rotting;
(4) the figures for moth damage in respect of covered potatoes on the racks and on the *pucca* floor are too eratic to lead to any definite conclusion.

Rahman's statement, therefore, that the percentage of losses due to moth attack as well as rotting was higher when potatoes were stored on the floor than when they were stored on racks and that saw dust, Lantana leaves, local grass and *bhusa* gave good results, is not borne out by his data. Indeed his only finding appears to be the well-known fact that covering potatoes with some suitable material minimises moth attack.

Lefroy and Evans (1910) experimented on potato storage at Pusa; these were repeated in certain areas in the Central Provinces. They concluded that the most effective and inexpensive method of storing potato against moth attack and rotting, was to keep them covered under a layer of sand and to examine periodically, specially during the rainy season, and pick out the attacked or rotting potatoes. This method has given varying degrees of success, depending, it appears, largely on the correctness and efficiency with which the method has been practised.

Following Rahman's clue, a laboratory experiment was conducted at Cawnpore in which lots of 16 potatoes were kept covered with sand, ash, saw dust, *bhusa*, ash mixed with lime, Lantana leaves and *Murraya koenigii* leaves, together with one lot uncovered as Control and exposed equally to the tuber moth attack. The experiment lasted from 14-9-1944 to 2-3-1945. The results have shown that potatoes, covered with sand, ash and ash mixed with lime, remained completely free from moth attack while other lots suffered heavily. The percentage of moth-attacked and rotten potatoes under Lantana leaves was 91·0 and 47·9 respectively against 0·0 and 8·3 under sand and 0·0 and under ash. The experiment is being repeated on large-scale and a full account of both may be published at a later stage.

Entomologist to the Government of U.P., Cawnpore, K. B. LAL.
March 28, 1945.

1. Rahman, Khan A., *Curr. Sci.*, 1944, **13**, 133. 2. Lefroy, H. M., and Evans, G., *Agri. J. India*, 1910, **5**, 19.

THE CHROMOSOME NUMBER OF *SACCHAROMYCES CEREVISIAE*

AFTER a survey of our knowledge of the cytology of yeasts Kater[1] concludes that while amitosis is of doubtful value as a process occurring during budding "the burden of proof still rests with both sides". We would like to add that an explanation should also be given as to why the chromosome number is given by Badian[2]

as two, by Sinoto and Yuasa[3] as four and by Kater[4] as probably eight. Badian is criticized (Guilliermond[5]) on the ground that his diagrammatic illustrations do not fit in with his own or Guilliermond's photomicrographs. Our uniform and consistent results[6] indicate that for the strain (S.C. 9, N.C.T.C.) investigated by us the chromosome number is two. This raises the question whether the different chromosome numbers given by various authors may not be due to studies of different races passing under the name of *S. cerevisiæ*? The numbers given by Sinoto and Yuasa and Kater are multiples of that given by Badian. Were they dealing with tetra and octoploids? If so, the results are not strictly comparable.

The previous workers must have seen what they described. Kater[1] while referring to his previous work on yeasts considers that since his success depended "to a certain extent on accident" it could not form the basis for a general acceptance of the conclusion by all workers until others manage to duplicate the results".

We have tried Bouin fixation and subsequent staining with Heidenhain's hæmatoxylin and find that the above technique reveals the two chromosomes seen in Carnoy-iron-hæmatoxylin preparations. It is not at all necessary that the cells should contain picric acid. Smears treated in the usual way would give good pictures of the chromosomes if the following precautions are taken.

(1) Use of wort cultures.
(2) Control of cultures in such a way that all cells are almost at the same phase of development.
(3) Experimental determination of the time of division.
(4) Fixation of wet smears.
(5) Long staining with iron-hæmatoxylin.
(6) Careful differentiation.

Our results suggest that the "accident" mentioned by Kater[1] is not the delicate balance between the dye and the acid but that the cells should be at some phase of the mitotic cycle. We cannot also agree with Henrici[7] that "descriptions of details in morphologic structures less than 1 μ in diameter should always be taken *cum grano salis*", since in our preparations no other structure is present in the cells to complicate the picture seen.

Why is it then, that even after filling up the "possible leak" in Kater's technique we see only two chromosomes, while Kater gives the number as possibly eight? Under the belief that Badian, Sinoto and Yuasa and Kater have been using different strains we carried out some experiments with acenaphthene. Polyploidy could be induced and on cytological examination of wort cultures after a few hours' treatment with the above chemical, one finds in every field cells with varying chromosome numbers. It appears, therefore, possible to produce a tetraploid or octoploid by controlling the time of treatment with acenaphthene. One curious fact which emerged from the preliminary experiments was the observation that the measurements of the chromosomes of the tetraploids need not agree with that of the diploids. Viewed in the light of the above discovery, it appears probable that different observers have been investigating different races passing under the name of *S. cerevisiæ*! If the above contention is substantiated, much of the genetical work on yeasts may have to be revised in the light of new facts revealed by cytology.

Our thanks are due to Mr. M. Sreenivasaya for his active interest and encouragement. One of us (M.K.S.) wishes to tender his grateful thanks to Messrs. The K. C. P., Ltd., Uyyuru, for the generous grant of a studentship.

Fermentation Technology Section,
Indian Institute of Science,
Bangalore, M. K. SUBRAMANIAM.
February 2, 1945. B. RANGANATHAN.

1. Kater, J. McA., *Bot. Rev.*, 1940, **6**, (4), 164–180. 2. Badian, J., *Bull. Inter. Acad. Polonaise, Sci. et Lettr. Ser. B*, 1937, 1/5, 61–87. 3. Sinoto, Y. and A. Yuasa, *Cytologia*, 1941, **11**, (3), 464–472. 4. Kater, J. McA., *Biol. Bull.*, 1927, **52**, 436–448. 5. Guilliermond, A., *Bot. Rev.*, 1940, **6**, (1), 1–24. 6. Curr. Sci., 1945, **14**, 78. 7. Henrici, A.-T., *Bact. Rev.*, 1941, **5**, (2), 97–179.

ON THE PRESENCE OF AN OBTURATOR IN THE OVULE OF *PHYLLANTHUS NIRURI* L.

IN a short note on the development of the embryo-sac of *Phylanthus niruri*, Maheshwari and Chowdry[3] (1937) reported the occurrence of a normal eight-nucleate megagametophyte when some previous workers had reported a five-nucleate one. Incidentally we also recorded the presence of an obturator in the ovule—a fairly common occurrence in Euphorbiaceæ. Recently Banerji and Dutt[2] (1944), in a work dealing with the development of the female gametophyte of *Putranjiva, Trewia, Euphorbia* and *Phyllanthus*, agree that the embryo-sac is eight-nucleate but report their failure to find an obturator either in *P. niruri* or *P. urinaria*, and suggest that Maheshwari and Chowdry probably mistook "the nucellar beak of the second ovule for an obturator". It is added that "in longitudinal sections, the nucellar beak of the second ovule sometimes gave the appearance of an obturator but close examination always revealed its true nature".

Since this is quite contrary to our observations and as the old slides on which the original study was based were no longer available for study, I sectioned some material of *P. niruri* collected from Dacca and am able to confirm our original statement that an obturator is clear and unmistakable. This is in agreement with the previous observations of Arnoldi[1] and others made several years ago on *Ceramanthus* (= *Phyllanthus*) (see Schnarf,[4] 1929, for literature). I am unable to offer any explanation as to why the obturator was missed by Banerji and Dutt[2] in their sections, but presume that their observations were made on non-median sections.

It may, therefore, be concluded that an obturator is present in *P. niruri* and is very

likely to be so in *P. urinaria* as well, although I have not examined the latter species myself.

Dacca University, P. MAHESHWARI.
March 5, 1945.

1. Arnoldi, *Trav. Mus. bot. Acad.*, St. Petersburg, **1912, 9, 136–54.** 2. Banerji and Dutt, *Proc. Ind. Acad. Sci.*, B, **1944, 20,** 51–60. 3. Maheshwari and Chowdry, *Curr. Sci.*, **1937, 5,** 535–36. 4. Schnarf, *Embryologie der Angiospermem*, Berlin, 1929.

INHERITANCE OF FRUIT POSITION IN A CHILLIE CROSS

A PURE breeding strain of chillies I.P. 34, a prolific bearer with fairly pungent fruits from the Imperial Agricultural Institute, Delhi, was crossed with another pure strain, 'Yellow Wax', from Sutton & Sons, highly prized for pickles, with a view to evolve a type combining the size of the 'Yellow Wax' with the pungent and prolific bearing characters of I.P. 34. The fruits are erect in 'Yellow Wax' while being pendent in I.P. 34. The results of the crosses regarding the position of the fruits are reported below.

In the F_1 of the cross 'Yellow Wax' I.P. 34 and I.P. 34 'Yellow Wax', the fruits were found to be mostly pendant with occasional erect early stages. From each of the above crosses two-selfed F_1 plants were grown as F_2. The segregation observed was into erect and pendant fruits, with a few cases of erect-pendant fruit position, the earlier stages being erect. The last type was included among the group of erect ones, since these fruits resembled that of the 'Yellow Wax' not only in being erect in the earlier stages but also in the later assumption of a pendant position owing to an increase in size and weight. The segregation observed is given in Table I.

From the F_2 of the cross I.P. 34 and 'Yellow Wax' four-selfed phenotypes and seven-selfed ones from its reciprocal cross were grown as F_3 in the subsequent season. Segregation was observed in one family of the former and five of the latter cross. The data are given in Table II.

The only significant deviation of the expected from the observed frequencies is in family F_2-67 where the value of P exceeds 0·20.

A single factor is, therefore, involved in the expression of the fruit position.

Shaw and Abdur Rahman Khan (1928) have used position of the fruit as a diagnostic character in classifying chillies. Deshpande (1933) has shown this character to be governed by a single factor. Our observation is also in accordance with that of Deshpande. Pendant position of fruit is dominant to erect and T 34 may be designated PP for this character and 'Yellow Wax' as PP.

The cross reported above was originally made in 1940, by the Junior author, Babu R. S. Roy. We are grateful to Dr. R. H. Richharia, Economic Botanist, Bihar, for providing us with facilities for this investigation.

Asst. Economic Botanist, Bihar, M. P. SINGH.
Senior Scientific Assistant, Botanical Section, Sabour, R. S. ROY.
January 9, 1945.

TABLE I

	I. P. 34 × Yellow Wax			Yellow Wax × I. P. 34		
	Pendant	Erect	Total	Pendant	Erect	Total
Observed ..	39	12	51	58	13	71
Expected ..	(3:1)38·25	12·75	51	53·25	17·75	71
	X^2 = ·059 P—0·80			X^2 = 1·695 P—0·2		

TABLE II

Yellow Wax × I. P. 34						I. P. 34 × Yellow Wax			
Family	Pendant	Exact	Total	X	P	Family	Pendant	Erect	Total
F 2—42 .	15	4	19	0·159	0·7	F 2—10	23	9	32
F 2—57 ..	19	6	25	0·013	0·9				
F 2—64 ..	5	3	8	0·67	0·8				
F 2—66 ..	22	9	31	0·269	0·7				
F 2—67 ..	18	10	28	1·7	0·2				
Total observed	79	32	111				23	9	32
Expected (3:1)	83·25	27·75	111				24	8	32
	X^2 = 0·868 P—0·5–0·3						X^2 = 0·167 P—0·5		

1. Deshpande, R. B., *Ind. Jour. Agri. Sci.*, **1933, 3,** Pt. 1. 2. Shaw, F. J. F., and Khan Abdur Rahman, "Studies in Indian Chillies," *Memoirs of Dept. of Agric. in India, Agric. Res. Inst.*, Pusa Botanical Series, **1928, 16,** No. 2. 3. Singh, M. P., *Ann. Rep. of the Bot. Sec.*, Depart. of Agric., Bihar, **1940–41.**

REVIEWS

The Measurement of Colour. By W. D. Wright. (Adam Hilger Ltd., London), 1944. Pp. vii + 223. 20*sh.* net.

A valuable addition to the literature on the science of colour has been made by the appearance of this book, written by one of the pioneer investigators in the field of colour measurement.

The science of colour is associated with the names of Goethe, Young, Helmholtz, Ostwald, Maxwell, Konig, Dieterici and Abney. These earlier workers saw the possibility of formulating a theory of colour, based on the fact that some as yet unexplained mechanism in the human eye, was able to respond to the three fundamental colour stimuli—red, green and blue, and that by the individual or simulanteous excitation of these three stimuli sensations corresponding to all the possible hues and the white, were obtained. The foundations of the trichromatic system of colour measurement were thus laid but it was not till the year 1923, that the first serious difficulties in the precise measurement of colour, were successfully overcome by Ives, Guild and Wright. The International Commission on Illumination in 1931 finally laid down the exact conditions for colour specifications by defining the illuminants A, B and C, and by specifying the colour response of the normal eye, very often spoken of as the standard I.C.I. observer.

With the essential requirements for colour measurements thus laid down on an international basis, it is now convenient to specify any colour on the trichromatic system, by a point on a rectangular chart, with only two of the trichromatic coefficients X and Y corresponding to the reddish purple and the green sensations. The third coefficient Z is given by the fundamental requirement $X + Y + Z = 1$. On such a co-ordinate system the colours of the spectrum lie on a 'hue-locus' which is in the form of a triangle. Any colour would then ordinarily correspond to a point within this triangle, the spectral blue and the red being at the left and right corners respectively, while the green is at the apex, and white at the centre.

It is obvious that such a system of colour specification requires instruments of precision whereby the three coefficients may be determined. The spectrophotometer is the earliest known and the best instrument for this purpose, but its use requires skilled manipulations. It is perhaps more practical whenever colour measurement is required to be carried out as a matter of routine, as for example, in various colour industries for their specifications, to employ, trichromatic colorimeters of the Guild or the Donaldson types. Lovibond tintometer in its most recent form serves the same purpose.

It is true that in spite of the exact specifications of colour thus made possible, secondary standards in the form of charts containing as many coloured patterns as possible would be continued to be used till a full sense of colour is generally developed and people learn to visualise the colours before them in terms of X, Y and Z coefficients. Colour atlases like The British Colour Council's dictionary of colours, containing some 200 patterns with their corresponding trichromatic coefficients and brightness factors, and the Munsell Colour charts calibrated in terms of trichromatic coefficients, largely used in America, thus form the necessary link between the ordinary and the scientific language of colour.

With the ever-increasing number of colours and their applications in various trades and industries, colour specification has assumed an importance, which was never fully recognised before. Dr. Wright has a great deal to say on all the points enumerated above and the book would greatly appeal to the student of colour physics. Intelligent layman who has anything to do with colour will also find in it portions which would lead him to a quick appreciation of the value of colour measurement. A remarkable feature of the book is the clarity of the text and its presentation.

Some of the charts and diagrams provided in the book are both original and interesting. Special mention may be made in this connection of one dealing with the location of various colours on a co-ordinate system of two of the trichromatic coefficients X and Y.

The illustration on the dust cover of the book is a little intriguing. The spectrum locus, with the position of some of the common colours indicated, and the artists pallette giving out three colours possibly the 'primaries' are well depicted. But who is the Onlooker? Does the robto-like head represent the I.C.I. observer endowed with a keen colour sense?

The book is altogether delightful and Dr. Wright may be congratulated on his success. There is no doubt it will find a place in the libraries of the educational institutions and industrial concerns which interest themselves in the teaching and application of the colour science.

B. K. VAIDYA.

Annual Review of Physiology, Vol. VI. By James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews, Inc., Stanford University P.O., California), 1944. Pp. viii + 630. Price $5.00.

This extremely useful, authoritative and indispensable review, as usual, contains a discussion of the progress achieved in several branches of physiology. Nineteen subjects covering the physiology of tissues and tissue-fluids, and the physiological functions and processes, are dealt with in this volume. The chapter on Development of Physiology is devoted

to a discussion of the process of development largely from the biochemical and functional points of view. Is neoplastic growth conditioned by chromosomal disturbances? What is the mechanism of the action of carcinogenic chemicals? How far do nutritional factors and harmones influence neoplastic growth? These and other interesting problems are discussed in the chapter on neoplastic growth. The physiology of the skin is the subject of an extremely interesting review by Rothman and Flesch. The rather specialised physiological functions of the skin, such as keratinisation, pigment formation and formation of long chain fatty acids and alcohols by the sebaceous glands, capillary permeability and percutaneous absorption, are specially emphasised. The bactericidal action of the ether-soluble lipoid fractions of the skin and its appendages, the ability of the skin and the follicular regions to absorb vitamins, hormones and even inorganic ions, are some of the practically significant observations which have been critically examined in this highly suggestive chapter. The review on physiological psychology presents an interesting and useful discussion of the "Three fields where the principles of physiological psychology are being developed most rapidly. These are (a) psychosurgery, (b) shock therapy, and (c) experimental neurosis."

Increasing importance has been given to the health of the industrial worker whose contributions to the prosecution of the war has received grateful appreciation. The efficiency of the worker depends upon his physical fitness, endurance and mental alertness. This new field of industrial physiology forms the subject of an interesting review which should be widely read. There are other equally interesting and valuable reviews, pertaining to both the fundamental and applied aspects of physiology. We have only taken a few examples at random and tried to invite attention to what has struck us at the first reading. These reviews are becoming increasingly indispensable not merely, to the wide circle of investigators in the field of physiology but also to the enlightened medical practitioner who desires to persue his profession with knowledge and understanding.

Intermediate Practical Chemistry. By P. B. Sarkar. Third Edition (revised and enlarged). (H. Chatterjee & Co., Ltd., Calcutta.) Pp. 166 + iv. Cost Rs. 1-12-0.

The long-felt need for the student of the Intermediate class (who is now mainly depending on the class notes for his guidance in the practical work) is more than satisfied by this lucid and concise book. The author has spared no pains in giving detailed instructions for many experiments described in this book. The first portion consists of eighteen preparation exercises which include the detailed instructions on the more elementary laboratory chemical practice such as maintaining the practical note book, experiments on solution, filtration, separation of the constituents of a mixture, preparation of chemicals, etc. The next section deals with inorganic qualitative analysis. The author has first given the individual tests for various basic as well as the acid radicals and then the general scheme of analysis. Unfortunately the general scheme of analysis is rather too brief to be easily understood by the student and it is hoped that this defect will be rectified in the next edition. The use of the balance and the experiments involving weighing such as determination of equivalent weights have been described next. It has to be pointed out, however, that a more elegant and accurate method must be given for the determination of the equivalent weight of zinc. A few more varieties of experiments could have been given in place of similar experiments like the determination of water of crystallisation of barium chloride, copper sulphate, etc. Amongst quantitative exercises only acidimetry and alkalimetry are given. It is very desirable to include a few more volumetric exercises like the titrations with $KMnO_4$, $K_2Cr_2O_7$, H_2O_2, etc. At one or two places (pp. 133, 148) the author suggests the pipetting out of concentrated sulphuric acid. In the opinion of the reviewer, this is a dangerous and an unnecessary habit, particularly for an Intermediate student. The last section of the book deals with some simple organic analysis like detection of carbon, hydrogen, halogens, etc., and also the determination of melting-point, boiling-point.

It is highly gratifying to note that there are very few mistakes and also that the price is quite low. It is hoped that the students of the Intermediate classes will be greatly benefited by this book on practical chemistry.

M. R. A.

Principles of Cereal Storage. By Dr. F. P. Coyne, Director of Storage, Department of Food, Government of India (November 1944).

It is curious that in a predominantly agricultural country like India, the question of combating pests and diseases of food-crops, should receive little attention in spite of the prevailing critical conditions of food shortage imposed by war. And yet, the pests and diseases of crops alone are directly responsible for the loss of crores of rupees worth of foodgrains.

Several countrywide schemes for growing more food have been launched; nowhere has the perpetual problem of protecting the very food in the process of its growth from their pests been given any serious consideration.

It is gratifying, however, that the Central Government have formed a Directorate of Storage as an adjunct to the Food Department which is entrusted with the task of properly preserving the harvested as well as imported foodgrains. One would wish that this had come into existence very much earlier and that similar directorates of "field campaign against pests and diseases" were also set up simultaneously all over India.

The handbook, *Principles of Cereal Storage*, published by the Food Department, embodies mostly the lectures delivered at a training course in the principles of grain storage, held

at the Imperial Agricultural Research Institute, New Delhi. As stated in the preface, by the author, 'this book is intended for the layman and strict scientific accuracy has been deliberately sacrificed, for the sake of clarity and brevity'.

Three main sources of loss in stored grain (loss estimated at about 3 millions of tons per annum), namely, moisture, insects and rodents, have been dealt with in an instructive manner in this book. The effect of climatic conditions on stored grains described with special reference to temperature and relative humidity, as exemplified in the case of typical inland and coastal towns like Calcutta and Bombay with a heavy monsoon and others like Karachi and Lahore with a light monsoon, is extremely revealing and acts as an eye-opener to those interested in grain storage. The close relation existing between moisture content of grains and insect development and heating and mould formation is thoroughly discussed and useful suggestions are made for minimising damage.

In dealing with insect damage to grain—qualitative and quantitative, the author has clearly pointed out the difficulties of accurately assessing damage, the fallacies of the procedure adopted by the trades people and discussed fully the correct methods of sampling and the derivation of extent of damage and loss. The standardisation of bins for bulk storage and godowns for bag-storage in India that has long been pending, has received the full attention of the author and the recommendation made, admit of ready and easy adoption almost all over the country especially at this juncture.

Of the different control measures against the insects affecting grains in storage, discussed in the book, fumigation stands out prominently. The author feels most confident in recommending widely the use of ethylene dichloride/carbon tetrachloride mixture for fumigating infested stocks.

It is hinted that the two new insecticides, "D.D.T." and "666"', expected in course of time, to be released for civilian use, would probably very effectively replace most fumigants in the treatment of premises and infested stocks. Because of the promise offered by these new synthetic products, the use of "Inert Dusts", in the opinion of the author, has but limited scope. Heat treatment of infested grains, while being effective on a small-scale, would offer obvious difficulties in large-scale work, one of them being, the proper control of temperature and avoiding damage to grain. The author also feels that no heating plant could be economically worked under the present conditions in India.

Rodent activity and damage to grain form a very important aspect of proper storage of foodgrains and the loss attributable to this agency alone might easily be a million tons of foodgrains. The problem of control has been very difficult all along. The measures suggested by the author in the work of eradication of the pest, deserve the serious attention, not only of all those concerned in the storage and distribution of foodgrains, but also of the public health authorities in this country.

The Royal Society (1660–1940)—A History of Its Administration under Its Charters. By Sir Henry Lyons. (Cambridge University Press), 1944. Pp. 334. Price 25*sh*.

This uncommon book was produced in uncommon circumstances. During June 1940 the gallant and lamented author, crippled with arthritis and approaching 76, began a fair draft, narrowly escaping death when his house was wrecked in that September. Bombed out of two hotels, he occupied five temporary homes far from libraries, reading the final proofs at Great Missenden where he died on 10th August 1944 just before publication, so closing an epic of the home front.

It may be said that when Francis Bacon (1561-1626) wrote, "Those, therefore, who determine not to conjecture and guess, but to find out and know; not to invent fables and romances of worlds but to look into and dissect the nature of this real world, must consult only things themselves", he opened the gateway of experimental science, besides giving largely unheeded good advice to slogan-ridden posterity. Soon after his death, there began to meet in London disciples interested in the new philosophy, and this Invisible College—Robert Boyle's name for the Philosophers' Society—owed immunity from religious persecution to its largely roundhead membership; later gaining protection through royal support when Charles II granted, in 1662, its first charter to the Royal Society of London for improving natural knowledge. This fortunate association is attributable to the first president, Lord Brouncker, and Sir Robert Moray, both being in favour at Court. It was no mere formality, because Pepys records that the alert-minded monarch "mightily laughed at Gresham College for spending time only in weighing of ayre and doing nothing else since they sat". This incident illustrates one of the infant society's growing pains, namely, public ridicule of the Fellows' labours, which were satirised by Steele, Addison, Swift, and more gently Pope.

Another sterner obstacle to progress was the preponderance of members who were not primarily interested in the new knowledge. The anniversary meeting of 1663 registered 131 Fellows comprising 18 noblemen, 22 baronets and knights, 47 esquires, 32 doctors, 2 bachelors of divinity, 2 masters of arts and 8 foreigners, of whom only one-third may be deemed scientific. The more decorative contingent had been elected in the unfulfilled expectation of providing monetary support, because seventeenth century enthusiasm for experiments appears to have been coupled with reluctance to pay the weekly shilling subscription. Two centuries were to pass before this obstacle was completely surmounted.

Immediately on receiving its charter the Society appointed as Curator Robert Hooke (1635-1703), Boyle's Assistant, "to furnish the Society every day they mett with three or four considerable experiments, expecting no recompense till the Society gett a stock enabling them to give it." He rendered most valuable service during forty years, first as demonstra-

tor and curator, then as Fellow-Councillor and Secretary; but seems to have shared with the porcupine its outstanding characteristic, and probably thereby postponed election of Sir Isaac Newton (1642-1727) to the presidency, which took place later in the year of Hooke's death and lasted twenty-four years. This period marks a turning point from decline and hardship, the Society acquiring (1710-80) its own home in Crane Court and beginning to make real progress continued under Sir Hans Sloane (1660-1753) who, following Newton, served the Society in various capacities during 63 years. Sir Joseph Banks (1743-1820), wealthy landowner and ardent naturalist, was president from 1778 to 1820, generously opening his London home to all men of learning and to travellers of note, while picturesquely presiding at the scientific meetings in court dress with decorations. The fellowship increased from 450 to 640, but the 2:1 proportion of non-scientific members persisted, while the president's wide and varied interests appear to have prevented him from giving an attention to the Society's finance and administration comparable with the precise conduct of his own affairs.

From 1821 a marked change is noticeable, coinciding with the accession of Sir Humphry Davy (1778-1829) to the presidency. By 1860 the reformers had completely amended the Society, and the scientific Fellows at last were more numerous than their colleagues who are now limited to those elected under statute 12. Among 467 Fellows at the close of 1944 the latter number 10, with 50 foreign members. Thus the Council is composed solely of scientific men who select twenty new Fellows each year, while "persons who have either rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society" may be selected on an annual average of one (Statute 12). Financially too, the Society had long ago reached smooth water, securities in the general purposes found amounting in 1833 to £14,000 and growing to £155,000 at the close of 1944: the aggregate of special funds, research funds and Warren research fund whose capital must be kept intact, greatly surpasses this amount.

Thus throughout its eventful growth, Sir Henry Lyons has traced administration of the Royal Society in painsgiving detail. Elected a Fellow in 1906, serving as Councillor, foreign secretary, vice-president and for ten years most ably and with great zeal as treasurer, he leaves a sterling monument to the venerable body he loved so well and served so well, with unfailing good humour and rare modesty.

M. O. F.

SCIENCE NOTES AND NEWS

During the course of a lecture on 31st March under the auspices of the Society of Biological Chemists, Bangalore, Sir J. C. Ghosh vividly described the changes that have come about in California during the last seventy years. The present prosperity of California was due not only to gold and oil but also to the vast irrigation scheme which supplies the necessary water for agricultural purposes. He pointed out how it has been possible for Californian fruit to be sold on the Calcutta market cheaper than fruit from the Punjab.

While describing the Tennesse Valley scheme, he pointed out how the project has stopped soil erosion in the area and how the use of phosphates manufactured in the tract itself from raw materials found locally and from power generated on the spot has made the lands fertile by its application to grow leguminous crops thereby enriching the soil with nitrogen also. He laid great emphasis on the prevention of wastage of irrigation water by stopping seepage from irrigation channels, on the measures taken to keep the tract free from malaria and on the measures adopted to facilitate traffic by promoting navigation as well.

All this has been done by adopting a long-range policy and by spending millions of dollars in the interests of the country without looking to an adequate immediate financial return. It was pointed out that a financial return of even 3 per cent. was considered satisfactory.

In our own country of India, many a big irrigation scheme has been put through in recent years and further schemes are under consideration. While people in America talk in millions of dollars our administrators very often hesitate to talk even in lakhs of rupees. While a return of 3 per cent. is considered satisfactory in that country, a guarantee of at least 6 per cent. is expected here. Measures to prevent the advent of malaria in an irrigation tract are rarely thought of and put into execution simultaneously with starting of irrigation. Furthermore, measures to prevent formation and rise of alkali in an irrigated tract thereby preventing soil deterioration are rarely thought of except after the problem has become very acute and land has begun to go out of cultivation.

Sir J. C. Ghosh laid great stress on the measures taken to prevent wastage of water in that country by making the irrigation channels quite water-tight to prevent seepage and percolation. He emphasised the great wastage of water in this country due to the nature of irrigation channels. While measures are being taken to form tarred and cement roads on a very large scale in the near future, we do not hear of any adequate measures to make our irrigation channels water-tight to avoid loss by percolation and seepage. Our people seem to be quite satisfied with a spectacular sight of a huge reservoir full of water without devoting much thought to the economic use of such water stored at great expense.

Just like the Tennesse Valley soils, our Indian soils too seem to be very much in need of phosphatic manures to build up soil fertility

and ensure big yields per acre. A suitable irrigation policy to enable the cultivator to grow leguminous crops by liberal phosphatic manuring and thereby enriching the soil with the much-needed nitrogen also is urgently called for.

If irrigated areas are kept free from malaria, measures are taken to prevent formation of alkali in the soil wherever necessary, and a suitable irrigation policy devised to make it easy to grow green manure crops it seems quite possible to double the yield from our lands already under cultivation in about 20 to 30 years. In that case, this country will be able to provide food for more than 500 million people.

While winding up the proceedings, Dr. Fowler, the Vice-President of the Association, laid stress that provided men and materials are available for work, money will be forthcoming by itself. I respectfully beg to differ from the above statement. While there are enough qualified men to undertake such work in this country, financing an agricultural scheme with a long-range policy seems to be rather difficult. The industrialist who always looks to an immediate big return is not interested in it and Government does not seem to be very keen on a long-range policy without the guarantee of an adequate return.

Our only hope lies in the many post-war development schemes that are now being forged and we trust that they do not get shelved with the return of normal conditions.

B. N. I.

In view of the importance of tobacco as a valuable commercial crop and the variety and complexity of problems relating to its production, processing and marketing, the Government of India have decided to set up an Indian Central Tobacco Committee on the lines of similar other Commodity Committees for Jute, Cotton, etc. The functions of the Committee will be to assist in the improvement and development of the production and marketing of tobacco and all matters incidental thereto. The Committee will devote its special attention to the improvement of the flavour and aroma of Indian tobacco, and research on these problems will be taken up shortly. The Government of India will finance the Committee by placing an annual grant of Rs. 10 lakhs at its disposal.

The Government of India have decided to expand the facilities for post-graduate training, and to admit fifty students a year from April 1945 onward at the Imperial Agricultural Research Institute, with a view to meeting the growing demand for the training of higher agricultural staff at the Centre and in the Provinces and States.

So far the Institute admitted on the average sixteen students per year for training in five sections. There will be now two more sections, i.e., Agricultural Engineering and Agricultural Economics and Statistics added to the Institute.

The total cost of the scheme for the first year would amount to Rs. 1,75,100 and will fit into the full Five Year Plan of the expansion of the Institute as a post-war measure.

Dr. Alagappa Chettiar has donated an additional contribution of two lakhs of rupees to the opening of a College of Technology in the Madras University. Dr. Lakshmanaswami Mudaliar, the Vice-Chancellor, in acknowledging the gift, referred to the munificence of the donor as the largest single contribution to the University.

The Nobel Prize for Chemistry for this year will be awarded to Dr. Chou-Hou-Fu, Dean of the Science College of the National Szechwan University, says the bulletin issued by the Chinese Ministry of Information. Dr. Chou will be the first Chinese to win the Nobel Prize.

The President, Forest Research Institute, has advised that the statement appearing in *Current Science* (March 1945, p. 84) that Sir Herbert Howard has been appointed Adviser to the Government of India on Forestry, is not correct. We deeply regret the error. We have been informed that Sir Herbert Howard has gone on leave preparatory to retirement.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of April 1945, there were eight of slight and one of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Remarks
		H. M.	(Miles)	
10	Slight	07 52	4460	
10	Slight	22 46	3290	
15	Moderate	09 05	5195	Epc. near Kamchatka
18	Slight	19 35	4165	
19	Slight	19 34	7245	
20	Slight	00 17	1730	
22	Slight	10 19	5190	
22	Slight	16 23	2055	
23	Slight	13 00	1555	

As we go to the Press, we have learnt with the deepest sorrow that Sir Martin Forster, formerly Director, Indian Institute of Science, Bangalore, and one of the principal founders of *Current Science*, passed away peacefully at his residence in Mysore on Wednesday, the 23rd May 1945.

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